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PRESIDENT'S MESSAGE

Uttar Pradesh State Ophthalmological Society

Dr. Shashank Kumar

It gives me immense pleasure to address all members, contributors, and readers through this esteemed issue of our State Journal of Ophthalmology. The journal continues to serve as a vital platform for sharing knowledge, clinical experiences, and advancements in the field of ophthalmology.

In an era of rapid technological progress and evolving treatment modalities, it is crucial for us, as eye care professionals, to stay updated and engaged with ongoing research and innovations. This journal reflects the dedication, academic rigor, and clinical excellence of our members across the state.

I commend the editorial team for their relentless efforts in maintaining high standards of publication and ensuring the dissemination of meaningful scientific content. I also encourage young ophthalmologists and postgraduate students to actively contribute, as research and publication are integral to professional growth and improved patient care.

Let us continue to work together with commitment and compassion to combat visual impairment and blindness, and to provide accessible and quality eye care to all sections of society.

I extend my best wishes for the continued success of the journal and look forward to greater participation from all members in the future.

Warm regards,

Dr. Shashank Kumar
President
Uttar Pradesh State Ophthalmological Society

UP Journal of Ophthalmology

CONTENTS

Padma Shri Prof. Dr. Sundaram Natarajan

Dr. Leela Panchakarla*

MBBS, MHA, Healthcare Executive, New York, USA

Introduction: A Dynasty of Light

There are careers in medicine that are distinguished, and there are careers that are defining. The distinction lies not in volume of output alone, but in whether the practitioner reshapes the intellectual, institutional, and human landscape of their discipline in ways that outlast their own tenure. By this criterion, the career of Padma Shri Prof. Dr. Sundaram Natarajan belongs unambiguously to the second category.

Ophthalmology, for Dr. Natarajan, is not a profession, it is a patrimony claimed and then vastly enlarged. Both his grandfather, Dr. Nataraja Pillai, and his father, Prof. Dr. N. S. Sundaram, being highly regarded figures in their respective eras[1]. Born on 4 September 1957 in Madurai, Dr. Natarajan spent his formative years within the residential quarters of the Government Ophthalmic Hospital, Chennai, where the daily spectacle of patients arriving in darkness and departing with restored vision became the defining moral experience of his childhood. This was an environment that did not merely inspire the study of ophthalmology; it made blindness personal, and its reversal urgent.

Dr. Natarajan received his early formal education at St. Antony's High School, Chennai, where academic discipline and structured thinking were emphasised, and subsequently at Madras Christian College Higher Secondary School. These institutions grounded him in the precision of thought that would later characterise both his surgery and his scienctific journey.

Dr. Natarajan graduated with MBBS degree in 1980 from Madras Medical College, Chennai, one of India's oldest, most prestigious, and competitive medical institution. His postgraduate training in ophthalmology at the Government Ophthalmic Hospital, the very institution where his father and grandfather had trained carried an uncommon weight of continuity. He was simply not continuing a career; he was continuing a conversation across generations about what medicine was for - to this world.

The decisive formative experience of Dr. Natarajan's specialist career came at Sankara Nethralaya, Chennai, where he trained under Padma Bhushan Dr. S. S. Badrinath, one of the founding figures of modern vitreoretinal surgery in India and himself, later, a Charter Inductee of the global Retina Hall of Fame. The guru-shishya relationship between Badrinath and Natarajan is one of Indian medicine's most consequential: both men now appear together on the Retina Hall of Fame's list of 100 greatest vitreoretinal surgeons worldwide, the only two Indians so honoured. Dr. Natarajan completed his Fellowship in Retina and Vitreous Surgery (FRVS) in 1985, having mastered advanced vitrectomy at a moment when the subspecialty was globally in its foundational decade. His subsequent credentials includes FAICO (2012), FRCS Glasgow (2018), FELAS (2019), and an honorary DSc, reflects a scholar who continued to formalise his expertise throughout his career.

Clinical Mastery & Institution Building

In 1988, Dr. Natarajan joined the Taparia Institute of Ophthalmology at Bombay Hospital, Mumbai, where he established the vitreoretinal department. By 1990, he had taken the decisive step of founding Aditya Jyot Eye Hospital Pvt. Ltd. - India's first institution exclusively dedicated to ophthalmology and vitreoretinal surgery and research. The name itself, meaning 'light of the eyes,' encoded the institution's purpose: not merely to treat disease, but to restore the fundamental human capacity for sight.

In 2004, the hospital expanded with the opening of its Wadala facility and the establishment of the Aditya Jyot Eye Bank, significantly enhancing access to corneal transplantation and tertiary ophthalmic care for Mumbai's

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Portrait of the Dr. S. Nataraja Pillai Family (1937). Left to right: Mrs. Parvathi Natarajan, N.S. Sundaram (aged 10; father of Dr. S. Natarajan), Dr. S. Nataraja Pillai (grandfather of Dr. S. Natarajan), and Lakshmi. Seated: Padmavathy

population. Under Dr. Natarajan's leadership as Chairman and Managing Director, Aditya Jyot Eye Hospital was ranked the most trusted eye hospital in Mumbai by Reader's Digest successively in 2017, 2018, and 2019[2].

The institution encompasses the Aditya Jyot Institute of Vision Science and Research, and the Aditya Jyot Eye Research Institute dedicated research infrastructure committed to translational investigation in areas including regenerative medicine, stem cell therapy for retinal degenerative diseases, artificial retina, and ophthalmic genetics. The Aditya Jyot Genetic Clinic the first of its kind in Maharashtra and among the first three in India, was established in memory of Prof. Dr. N. S. Sundaram and committed to hereditary eye disease research[3].

Over his career, Dr. Natarajan has performed more than 65,000 advanced vitreoretinal procedures, encompassing complex vitrectomy, retinal detachment repair, proliferative diabetic retinopathy surgery, epiretinal membrane and macular hole repair, and reconstruction of severely traumatised eyes. He is recognized in the Limca Book of Records for pioneering India's first entirely sutureless scleral buckling procedure and the initial sutureless 23-gauge vitrectomy, innovations that minimized surgical trauma, shortened recovery periods, and advanced the standard of minimally invasive vitreoretinal surgery in the country[1].

His 2018 paper in the Indian Journal of Ophthalmology describing the 'claw' forceps a novel instrument for intraocular foreign body removal, exemplified his impulse to convert operative experience into transferable technical innovation[4]. He has regularly performed live surgery demonstrations at national and international workshops, where his operative precision has influenced a generation of vitreoretinal surgeons across 81 countries. He has delivered more than 1,517 invited guest lectures nationally and internationally. He holds professorial appointments at the Maharashtra University of Health Sciences, the National Board of Examinations (New Delhi), and visiting positions at Saveetha University (Chennai), Maimonides University (Argentina), and ESASO (European School for Advanced Studies in Ophthalmology, Lugano). Through this seamless synthesis of surgical artistry, institutional building, and relentless technical innovation, Dr. Natarajan has not only redefined ophthalmic care but has established a visionary blueprint for the future of sight restoration.

Research Work: A Scientific Legacy Across Four Decades

The measure of a scientist's impact is not tallied solely in publication counts or citation indices. It is found, more honestly, in whether the knowledge generated changes what practitioners do, whether it alters a clinical decision, redirects a national health programme, or places an instrument of diagnosis in the hands of a community health worker for a patient who could not otherwise afford a subspecialist. By this measure, the research career of Dr. Sundaram Natarajan - vitreoretinal surgeon, public health investigator, editorial statesman, and pioneer of technology-enabled eye care represents one of the most consequential scientific contributions in the history of Indian ophthalmology. His research does not cluster around a single theme or subspecialty convenience. It spans vitreoretinal surgery, diabetic retinopathy epidemiology, artificial intelligence-enabled screening, ocular trauma systems, retinal genetics, and ophthalmic education, a breadth that reflects not dilettantism, but an unyielding responsiveness to wherever the discipline's greatest unmet needs resided.

Dr. Natarajan's first peer-reviewed publications, emerging in the late 1980s from his formative years at Sankara Nethralaya, Chennai, were written at a moment when

Presentation of the All-Round Trophy (1980)
S. Natarajan, final-year MBBS student and Captain of the Athletic Team at Madras Medical College, receives the All-Round Trophy from the Chief Guest.

vitreoretinal surgery was itself still consolidating its theoretical and technical foundations globally. His early output was therefore not merely descriptive; it was constitutive of the subspecialty's Indian literature.

In 1987, he contributed to a landmark series of papers on complex vitreoretinal conditions that appeared in the Indian Journal of Ophthalmology. These included a systematic analysis of silicone oil tamponade in proliferative vitreoretinopathy documenting operative technique, post-operative management, advantages, and limitations at a time when PVR remained the most feared cause of surgical failure in retinal detachment repair[5] as well as co-authored work on the management of giant retinal breaks[6] and a study on the role of pars plana filtration in intractable glaucoma that bridged vitreoretinal and glaucoma surgery at the frontier of both disciplines[7]. His investigations in this period further encompassed pneumoretinopexy, acute retinal necrosis syndrome, and the surgical management of retinal detachment with macular holes, each representing a domain where evidence was sparse and clinical guidance was urgently needed. These works, published variously in the proceedings of the All India Ophthalmological Society conferences and institutional journals, provided the operational scaffold upon which a generation of Indian vitreoretinal surgeons built their practice.

By 1995, his collaborative contribution to the Indian Journal of Ophthalmology review on the diagnosis and management of postsurgical endophthalmitis - co-authored with Das, Dogra, Gopal, and others had established itself as an enduring clinical reference[8].

Athletic Achievement at Madras Medical College (1977)
S. Natarajan receiving medals for the 10,000-meter and 5,000-meter track events during the Madras Medical College Annual Sports Meet.

Dr. S. Natarajan pictured with his mentor, Padma Bhushan Dr. S.S. Badrinath, at the Aditya Jyot Eye Hospital in 2001.

The epidemiology of diabetic retinopathy in India presents a challenge of extraordinary complexity: a nation of 1.4 billion people, with heterogeneous socioeconomic geographies, a rapidly expanding burden of type 2 diabetes, and a specialist workforce that cannot hope to individually examine every at-risk individual. Dr. Natarajan recognised, earlier than most, that the response to this challenge required not only better surgery or better drugs, but better data and, ultimately, better systems. His research in diabetic retinopathy has accordingly operated simultaneously at the level of the individual patient, the urban slum, and the national policy framework.

The Aditya Jyot Diabetic Retinopathy in Urban Mumbai Slums Study conceived, designed, and conducted under his leadership was established with a specific and underserved focus: to quantify the burden of DR and its determinants in one of the world's densest and most socioeconomically marginalised urban populations. The study's foundational methodology paper, published in Ophthalmic Epidemiology in 2014, detailed a rigorous epidemiological architecture that would yield sustained, citable data across multiple reports[9]. The 2017 prevalence report confirmed high rates of DR in this vulnerable cohort, findings with direct relevance to public health planning and resource allocation[10]. A subsequent report, examining patterns of risk for DR in the Mumbai slums and published in PLOS Global Public Health in 2023, extended this longitudinal evidence base and identified modifiable risk determinants amenable to intervention[11]. A further 2023 publication in the Indian Journal of Ophthalmology examined the impact of individual counselling on the knowledge and attitudes of type 2 diabetics regarding DR, a dimension of the study that acknowledged that clinical outcomes are inseparable from patient understanding[12].

At the national level, Dr. Natarajan's participation in the SMART India population-based cross-sectional study produced two of the most widely cited papers in Indian ophthalmic epidemiology. The 2022 Lancet Global Health

publication reporting DR prevalence in India stratified by known versus undiagnosed diabetes, urban versus rural location, and socioeconomic indices provided, for the first time, a nationally calibrated estimate that disaggregated the DR burden with methodological rigor sufficient to inform targeted policy[13]. The companion paper, published in the same journal in 2024, reported the national prevalence of vision impairment and blindness attributable to diabetes in adults aged 40 years and older, a landmark finding establishing the true scale of diabetes-related visual morbidity in the country and identifying subgroups at highest risk[14]. Publication in The Lancet Global Health, the world's foremost journal in global medicine placed this work in the highest tier of international visibility.

His engagement with the India Retinal Disease Study Group yielded a further significant publication in Ophthalmic Research in 2021, examining the need for vitreous surgery in proliferative diabetic retinopathy over a ten-year follow-up period, one of the few long-term surgical outcome datasets in this domain from the Indian subcontinent[15]. Complementing this, his 2020 contribution to a Scientific Reports paper on the prevalence and incidence of visual impairment in proliferative DR in India provided population-level evidence on a complication that, untreated, results in irreversible blindness[16].

Ocular trauma remains among the most consequential and systematically under-researched causes of preventable visual morbidity worldwide, disproportionately afflicting young, working-age adults in resource-limited settings with lifelong clinical sequelae. Dr. Natarajan's contributions to this field are international in their collaborative scope and methodologically significant in their impact.

Ocular trauma remains among the most methodologically fragmented fields in ophthalmology. Dr. Natarajan has addressed both dimensions: the clinical and the scientific infrastructure, through sustained international collaboration. His contributions to the International Globe and Adnexal Trauma Epidemiology Study (IGATES), coordinated through the Asia-Pacific Ophthalmic Trauma Society, yielded two landmark papers in Graefe's Archive for Clinical and Experimental Ophthalmology (2021): one establishing multicentre epidemiology and outcomes of open globe injuries[17], the other advancing the methodology of ophthalmic trauma clinical registries[18]. In 2022, his inclusion as a named contributor to the Globe and Adnexal Trauma Terminology Survey in JAMA Ophthalmology, an international Delphi consensus establishing unified classification language, reflected his standing as a globally recognised authority in this domain[19]. His 2017 paper on vitrectomy timing in posterior segment trauma remains a standard surgical reference[20], his 2023 Springer chapter on intraocular foreign body management a definitive subspecialty text[21], and his leadership of the AIOS writing group producing the 2020 COVID-19 ocular trauma guidelines a demonstration of research expertise translated into real-time national policy[22].

Dr. S. Natarajan with actor Hrithik Roshan during a public health campaign promoting eye donation awareness and pledging (2009).

Dr. S. Natarajan with legendary actor Rajinikanth (2009)

Dr. Natarajan's scientific contributions extend from the epidemiological to the technical and methodological. His 2018 description of the 'claw' forceps, a novel instrument for intraocular foreign body retrieval, exemplified the surgeon-scientist's impulse to formalise operative experience into reproducible innovation[23]. Through the CORDS Study Group, he co-authored two simultaneous 2021 papers in JAMA Ophthalmology that addressed a long-standing gap in vitreoretinal surgical research: a new classification system for complications in retinal detachment trials[24] and a systematic review of historical complication reporting using the CONSORT extension for harms[25], both now regarded as field-defining methodological contributions. His 2023 co-authorship on macular surgery classification in the Journal of Ophthalmology, alongside Forlini, Rizzo, Rejdak, and Avitabile, placed him within the international faculty shaping posterior segment surgical taxonomy[26]. In ophthalmic genomics, his involvement with the Keratoconus International Consortium (KIC)[27] and the Asian Eye Genetics Consortium (AEGC)[28] broadened his collaborative scientific reach, while his 2024 BMC Ophthalmology paper on cognitive workload in three-dimensional versus conventional microscopy macular hole surgery represents his most recent contribution to surgical ergonomics evidence[29].

When COVID-19 transformed ophthalmic practice, Dr.

Natarajan responded with scientific immediacy across multiple registers. He co-authored the AIOS, Indian Journal of Ophthalmology national consensus statement on preferred practices during the pandemic (May 2020)[30] and the companion consensus on post-COVID vitreoretinal and uveal management[31]. An early clinical report describing central retinal vein occlusion with COVID-19 as the presumptive etiology contributed timely evidence to the nascent literature on the disease's ocular vascular sequelae[32]. Subsequent contributions on choroidal microvascular alterations in Ocular Immunology and Inflammation[33] and on the retinal vascularity index in Ophthalmology and Therapy[34] demonstrated a sustained and methodical engagement with the ocular consequences of systemic viral disease long after the acute phase of the pandemic had passed.

Dr. Natarajan's 2019 JAMA Ophthalmology paper, his most globally cited publication demonstrated that an offline AI system on a consumer smartphone could detect referable diabetic retinopathy with accuracy comparable to trained graders, without internet connectivity, in a Mumbai community setting[34]. The work progressed systematically: a 2021 Indian Journal of Ophthalmology study confirmed offline AI feasibility in community screening[35] ; a 2022 paper documented programme-level implementation through a city-wide teleophthalmology initiative[36] ; and a 2023 Telemedicine and e-Health publication established algorithmic reliability on ungradable images under real-time field conditions[37] collectively representing the most operationally grounded body of ophthalmic AI evidence from any single South Asian institution.

A dimension of Dr. Natarajan's scholarly legacy that resists easy quantification, no impact factor or no citation index is his decade as Editor-in-Chief of the Indian Journal of Ophthalmology (2011–2017). His editorials on predatory journals[38] , the ethics of salami publishing[39] , the relevance of indexed publications[40] , and the responsibilities of peer review[41] constitute a coherent, prescient curriculum in scientific culture; one that shaped how an entire generation of Indian ophthalmologists understood their obligations to evidence and to the integrity of the published record. Influence of this kind is diffuse, cumulative, and impossible to measure; it is also, for precisely those reasons, among the most durable contributions a senior clinician-scientist can make to a developing academic discipline.

Conferment of the Padma Shri (2013)
Dr. S. Natarajan receiving the Padma Shri, India's fourth-highest civilian honour, from the President of India, Pranab Mukherjee, at Rashtrapati Bhavan on April 20, 2013

The research legacy of Dr. Sundaram Natarajan is, at its most fundamental, a story about what clinical science is for. It is for the patient in a Mumbai slum whose referable diabetic retinopathy is detected by an AI on a smartphone before the window for treatment closes. It is for the trauma surgeon in a resource-limited setting consulting an international guideline co-authored by a peer who understands identical constraints. It is for the resident who reads an editorial reminding them that scientific integrity is the foundation upon which all clinical progress rests. The publications enumerated here are the vessels of that purpose, but the purpose itself, pursued with uncommon consistency over four decades and across every dimension of a complete academic career, is the true measure of a living legend.

Few physicians in Indian medical history have converted clinical conviction into verifiable, globally witnessed proof the way Dr. Natarajan has - not once, but repeatedly, and across disciplines.

Marked by Excellence, Honoured Across Continents: Achievements, Records, Awards, and Leadership

In February 2019, under the Aditya Jyot Foundation for Twinkling Little Eyes with support from Tata Trusts, Dr. Natarajan's team set a Guinness World Record by screening 649 patients with diabetes for diabetic retinopathy within eight hours in Dharavi, Mumbai, using a portable fundus camera. This initiative demonstrated the operational feasibility, clinical validity, and public health urgency of large-scale screening in underserved urban settings.

In 2017, Dr. Natarajan was inducted as a Charter Inductee into the Retina Hall of Fame, an international recognition of the 100 most influential contributors to vitreoretinal surgery. He is among a select group of Indian surgeons included in this distinction.

He is also listed in the Limca Book of Records for pioneering the first completely sutureless scleral buckling procedure and the first sutureless 23-gauge vitrectomy in India, reflecting early adoption and advancement of minimally invasive vitreoretinal techniques.

In response to the 2016 Kashmir civil unrest, Dr. Natarajan led a surgical team to Srinagar, where he performed 47 complex vitreoretinal procedures over 72 hours and contributed to the management of over 200 pellet-related ocular injuries. This effort earned him the State Award for

Meritorious Public Service from the Government of Jammu and Kashmir.

The recognition accorded to Dr. Natarajan has come from governments, academies, and institutions across the world; a geography of honour that maps, precisely, the international reach of a career anchored in India.

Honours and Decorations

Year	*Award*	*Detail*
2005	Gusi Peace Prize (Philippines)	Excellence in Ophthalmology and Humanitarian Service
2006	Distinguished Service Award - APAO	Asia-Pacific Academy of Ophthalmology, Singapore & Busan
2006	Man of the Year	American Biographical Institute
2008	Outstanding Citizen of Maharashtra Award	Government of Maharashtra
2009	Achievement Award - AAO	American Academy of Ophthalmology
2012	Achievement Award - APAO	Asia-Pacific Academy of Ophthalmology
2013	Padma Shri	4th highest civilian honour, Government of India, awarded by President Pranab Mukherjee on 20 April 2013
2016	Limca Book of Records - National Record	First completely sutureless scleral buckling; first sutureless 23G vitrectomy in India
2017	Charter Inductee - Retina Hall of Fame	One of only two Indians listed; alongside Dr. S. S. Badrinath and global legends including Charles Schepens and Allvar Gullstrand
2018	SAO Excellence Award	SAARC Academy of Ophthalmology, Nepal
2018	Senior Achievement Award - AAO	American Academy of Ophthalmology
2018	FRCS Glasgow	Fellowship of the Royal Colleges of Surgeons
2019	Guinness World Record	Most diabetic eye screenings in 8 hours (649 patients, Dharavi, Mumbai; supported by TATA Trusts)
2019	FELAS	Fellow of European Latino American Society of Ophthalmology
2020	Commemorative Postal Stamp	Honouring the Indian Journal of Ophthalmology during his tenure as Editor-in-Chief

Leadership within the All India Ophthalmological Society (AIOS)

Dr. Natarajan's most structurally consequential institutional role has been his progressive, three-decade stewardship of the All India Ophthalmological Society (AIOS) - India's largest ophthalmological body with over 17,000 members. His trajectory within AIOS represents a complete ascent through every significant office, from committee membership to the Presidency:

Period	*Role / Position*
1993–1999	Scientific Committee Member
2002–2008	Chairman, Scientific Committee (elected twice)
2008–2011	Chairman, Academic & Research Committee
2011–2017	Editor-in-Chief, Indian Journal of Ophthalmology
2017–2018	Vice President
2018–2019	President-Elect
2019–2020	President
2020–2021	Immediate Past President
2021–2022	Chairman, International Committee of Diabetic Retinopathy Screening
2023–2024	Advisory Role, AIOS National Diabetic Retinopathy Task Force

As AIOS President (2019–2020), he inaugurated STOP Diabetic Blindness, Jyot se Jyot Jalao: a nationwide initiative to screen every diabetic patient in India through teleophthalmology, converting a specialist-dependent examination into a community-deployable, AI-augmented service. In 2014, he launched the world's first vertical Amsler Garden, a public visual field education innovation and inaugurated 'Eye Screening on Wheels', a mobile diagnostic platform for underserved populations.

International Leadership Positions

Dr. Natarajan simultaneously holds and has held leadership in the following international bodies:

Position	*Organisation*
Board Member	International Society of Ocular Trauma
Immediate Past President	Asia-Pacific Ophthalmic Trauma Society
Past President	Ocular Trauma Society of India
President	Tele-Ophthalmology Society of India
Vice President and Treasurer	Global Eye Genetics Consortium
Member	The Retina Society (USA)
Past Regional Managing Editor	EyeWorld Asia Pacific (Indian edition), APACRS
Chief Patron	Sankara Nethralaya Alumni Association, Madras
Past President	Organised Medicine Academic Guild (OMAG)
Chair	Kamala Sundaram Foundation
Founder Chair	Sundaram Natarajan Blind-Free India Foundation

Vision for a Blind-Free India

The next chapter of Dr. Natarajan's public career is not a diminuendo but an amplification. Having established clinical, research, and educational institutions of national significance, he has redirected the accumulated institutional force of his

Ophthalmic Innovations and Services Introduced for the First Time in India by Prof. Dr. Sundaram Natarajan[2]:

Innovation / Service	*Description*
First Exclusive Vitreoretinal Centre	Established India's first institution dedicated exclusively to vitreoretinal surgery (1990)
BIOM (Binocular Indirect Ophthalmo-Microscope)	First introduction of wide-angle observation system for vitreous surgery in India
Photodynamic Therapy (PDT)	First use of PDT for Central Serous Retinopathy (CSR) and Choroidal Neovascular Membrane (CNVM) in India
25G Vitrectomy	First Micro Incision Vitrectomy Surgery (MIVS) in India
27G Vitrectomy	First Micro Mini-Incision Vitrectomy Surgery in India
Perfluorocarbon Liquid (BIOM)	First introduction in vitreoretinal surgery in India
Injection Lucentis (Ranibizumab)	First anti-VEGF injection introduced in India
Injection Macugen	First anti-VEGF injection of its class introduced in India
Injection Vabysmo	First anti-VEGF injection of its class introduced in India
Natarajan Macuseal™	World's first desiccated amniotic membrane engineered specifically for retinal surgery; addresses macular hole closure, giant retinal tear (GRT) repair, and optic pit closure; GMP-certified, gamma sterile, available in sizes 500–1000 microns; developed in collaboration with Akriti Ophthalmic Pvt. Ltd.

Dr. S. Natarajan with the Vice President of India, C.P. Radhakrishnan, following the Vice President's formal pledge to donate his eyes. This collaboration serves as a national endorsement, encouraging the public to support eye donation initiatives (2026).
Source: Vitretinamaster.com. (n.d.). Prof. Dr. S. Natarajan — biography and foundation. https://www.vitretinamaster.com/bio

career toward a single, explicitly articulated national goal: a Blind-Free India.

The Kamala Sundaram Foundation and the Sundaram Natarajan Blind-Free India Foundation drive a nationwide programme encompassing free eye screening camps, diabetic retinopathy detection, mobile diagnostic units, surgical outreach, training and capacity-building centres, and public awareness campaigns across India's geographic breadth. These are not philanthropic adjuncts to a hospital enterprise; they are a deliberate strategy to address avoidable blindness as a national health priority, operating at a scale that individual clinical institutions cannot achieve alone. The unifying objective remains clear: a Blind-Free India through early detection, equitable access, and sustainable clinical systems.

Conclusion: Witnessing a Living Legend

Legends in medicine are often constructed retrospectively; their significance apparent only after the innovations have been validated by time and the institutions have outlasted their founders. What makes Dr. Sundaram Natarajan a living legend is that his significance is already fully apparent, his institutions are operational, his research is policy-forming, and his moral purpose has not diminished with professional achievement.

He is the surgeon who operated on pellet victims in Kashmir under curfew; the epidemiologist whose DR data appeared in The Lancet; the AI researcher whose smartphone trial appeared in JAMA; the editor who taught a generation what good science looks like; the institution-builder who created India's best vitreoretinal hospital; and the public health visionary who set his sights on nothing less than eliminating preventable blindness from a nation of 1.4 billion people.

For the readers of the UP Journal of Ophthalmology - practitioners, residents, researchers, and public health professionals across Uttar Pradesh and beyond, the career of Padma Shri Prof. Dr. Sundaram Natarajan is not merely an inspiration. It is an operational model: of what is possible when surgical excellence, scientific rigor, institutional commitment, and humanitarian purpose are pursued, simultaneously, without compromise, across an entire career.

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Research Article

Prevalence of Visual Impairment and Ocular Disorders Among Brass Industry Workers in Moradabad, India: A Cross-Sectional Study

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Abstract

Purpose: To evaluate the visual status and ocular disorders among brass industry workers in Moradabad, Uttar Pradesh, India, focusing on the prevalence of visual impairment, refractive errors, and the usage of personal protective equipment (PPE).

Methods: A cross-sectional descriptive study was conducted in five small-scale brass industries in Moradabad, U.P, India. A total of 351 workers participated, with data collected on age, job roles, PPE usage, and ocular morbidity. Visual acuity was assessed using a Tumbling E chart for distance and Snellen's near vision chart. Refractive errors were identified through retinoscopy, and color vision was evaluated using Ishihara plates. Anterior segment abnormalities were checked with a flashlight examination. Data analysis was performed using SPSS software version 16.

Result: The mean age of participants was 38.5 years, with a significant male majority (93.16%). Among the participants, 8.26% had visual impairment (VI), with refractive errors (68.96%) and cataracts (24.14%) being the leading causes of VI. The prevalence of myopia, hypermetropia, and presbyopia was 23.36, 14.25, and 48.72%, respectively. Cataracts were noted in 10.54% of workers, while other ocular abnormalities included conjunctival and corneal disorders. Only 5.98% of workers reported using personal protective equipment (PPE), highlighting a significant gap in occupational safety practices.

Conclusion: The study underscores a high prevalence of uncorrected refractive errors, presbyopia, and cataracts among brass industry workers and low PPE usage. Targeted interventions, including vision screening, provision of corrective eyewear, and workplace safety improvements, are essential to mitigate occupational eye health risks in this vulnerable workforce.

Keywords: Occupational hazards, Brass industry, Visual impairment, Refractive errors, Ocular health, Personal protective equipment.

Introduction

Occupational hazards, significantly contribute to disability and mortality rates among workers worldwide. These hazards are a leading factor in causing severe health issues and fatalities in the global workforce.[1,2] The brassware industry in India is predominantly situated in the North-Eastern region of Uttar Pradesh, with Moradabad district being a major hub. This district alone is responsible for producing 80% of the country's brassware and contributes to 75% of its exports.[3] Moradabad, a city in Uttar Pradesh, is famously known as "Peetal Nagri (City of Brass)", reflecting its status as a major hub for brass manufacturing and export. This vibrant industry is the backbone of the local economy, providing employment to thousands of workers involved in various stages of brass production.[4] However, the brass industry in Moradabad presents considerable health hazards, particularly respiratory and cardiovascular diseases, due to workers' exposure to tin, lead, and various chemical vapors throughout the manufacturing stages. These stages include ingot production, melting and casting, scraping, polishing, and welding.[5,6] Studies have highlighted that industrial environments, including mines, chemical plants, and petroleum industries,

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are associated with high incidences of refractive errors, presbyopia, and other ocular disorders.[7-11] The brass industry, with its unique combination of metalworking and chemical exposure, presents a similar risk profile. Workers in these environments are subject to a variety of ocular hazards, including exposure to metal dust, chemical fumes, and physical eye strain from detailed craftsmanship. These factors can contribute to a higher prevalence of vision-related problems among these industrial workers compared to the general population.

Many of these hazards are preventable with adequate safety measures. One critical preventable issue is uncorrected refractive errors, which often lead to eye injuries in industrial settings.[7] Uncorrected vision problems can impair a worker's ability to perform tasks accurately, increasing the likelihood of accidents and reducing overall efficiency.

Despite the known risks, there is a paucity of studies specifically examining the visual and refractive status of workers in the brass industry, especially in the small-scale brass industries of Moradabad district. This study aims to fill this gap by detecting vision impairment and ocular disorders among brass industry workers in Moradabad.

Materials And Methods

A cross-sectional descriptive study was conducted in five small-scale brass industries of Moradabad with written permission from industry officials and informed consent from participants, who were allowed to withdraw at any time. The institutional review board approved the study.

The examination team included a senior optometrist with over five years of experience and two junior optometrists with two years of experience. Data collected covered participants' age, job roles, use of personal protective equipment (PPE), and use of spectacles. Workers with less than one year of experience were excluded.

Visual acuity for distance was tested using a Tumbling E chart at 6 m. Participants with significant vision loss underwent further tests for finger counting, hand movements, light projection, and light perception. Visual acuity with current prescriptions was recorded for those wearing glasses. Subjects with distant visual acuity less than 6/6 were refracted with a retinoscope to identify refractive errors.

Near visual acuity was assessed using a Snellen near vision chart, and near correction was provided for those with acuity less than N8 to rule out presbyopia. Color vision was evaluated with Ishihara plates, and results were classified as normal or abnormal. A flashlight examination checked for anterior segment abnormalities, including the eyelids, sclera, conjunctiva, cornea, iris, and lens. The Hirschberg corneal reflex test and ocular movements were assessed using the broad H test with a flashlight.

Study Definitions

In the current study, visual impairment (VI) is classified based on the WHO criteria with some modifications. Presenting visual acuity (PVA) in the better eye is categorized as follows: 6/12 or better as no VI, worse than 6/18 up to 6/60 is considered moderate visual impairment, worse than 6/18 up to 3/60 is classified as severe VI, and worse than 3/60 is defined as blindness.[12] Refractive error was defined based on the retinoscopy findings. Uncorrected presbyopia was defined as binocular near vision worse than N8 at the subject's customary working distance in individuals aged over 35 years.[13] Presbyopia was treated as a separate condition, as it affects near vision irrespective of a worker's myopic or hyperopic status. Cataract was defined as an opacity of the crystalline lens in the pupillary area, causing visual impairment (presenting visual acuity worse than 6/18 and not improving with pinhole).[14]

In cases where there was more than one cause of VI, the cause that was more easily treatable or correctable to achieve a visual acuity of 6/18 or better was considered the primary cause. For example, if an individual had both cataract and uncorrected refractive error, uncorrected refractive error was considered the primary cause of VI. All subjects were informed about the findings, and those with refractive errors such as myopia, hypermetropia, and presbyopia were provided with spectacles. Abnormal findings noted during the examination were referred to a higher center for further evaluation and management.

The data was entered into an MS Excel database (Microsoft Office 2007). Statistical Package for the Social Sciences (SPSS) software version 16 was used for data analysis. Results from the study were presented using descriptive and inferential statistics.

Result

The study included a total of 351 workers (Table 1), with a significant majority being male (327 workers, representing 93.16%) and a smaller proportion being female (24 workers, representing 6.84%). The age distribution of the workers was as follows: 86 workers (24.50%) were aged between 19 and 28 years, 87 workers (24.79%) were aged between 29 and 38 years, 107 workers (30.48%) were aged between 39 and 48 years, 45 workers (12.83%) were aged between 49 and 58 years, 21 workers (5.98%) were aged between 59 and 68 years, and 5 workers (1.42%) were aged between 69 and 79 years.

Prevalence of Visual Impairment

Table 3 shows distributions of the VI based on the WHO criteria for VI [12], the distribution of VI among the workers was as follows: 322 workers (91.73%) had no VI, 24 workers (6.84%) had mild to moderate VI, 5 workers (1.42%) was classified as having severe VI and none of the workers were came under blindness category. Of all the visually impaired subjects, 20 (68.96%) had refractive error, and 7 (24.14%) had cataract as a major cause of VI. Additionally, Table 4 shows the distribution of visually impaired workers with moderate and severe visual impairment (VI) across different occupational tasks. Among 29 workers with VI, 24 had moderate VI, while 5 had severe VI. Males constituted the majority (93.1%). The most frequently performed tasks were scraping (n=8),

Table 1: Distributions of workers according to age groups and gender

	Characteristics	*Frequency (N)*	*Percentage (%)*
Gender	male	327	93.16
	female	24	6.84
Age (years)	19-28	86	24.50
	29-38	87	24.79
	39-48	107	30.48
	49-58	45	12.83
	59-68	21	5.98
	69-79	5	1.42

Table 2: Distribution of Workers occupation

Occupation	*Frequency (N)*	*Percentage (%)*
Scraping	83	23.6
Polishing	65	18.5
Packing	44	12.5
Embroidery	31	8.8
Welding	25	7.1
Rings creating	23	6.6
Casting	22	6.3
Brass repairing	16	4.6
Engraving	12	3.4
Lathing	11	3.1
Embosing	9	2.6
Manufacturing	4	1.1
Moulding	4	1.1
Administrative	1	0.3
Designing	1	0.3

polishing (n=4), and engraving (n=3). Workers with severe VI were primarily involved in casting, engraving, and polishing.

Refractive Error

Graph 1 illustrates refractive error distribution across age groups, focusing on emmetropia, myopia, and hyperopia. Emmetropia is most prevalent among younger individuals, with 67, 63, and 61 cases in the 19 to 28, 29 to 38, and 39 to 48 age groups, respectively, but it declines in older groups (12 cases in 49–58 and 6 in over 59). Myopia peaks in the 29 to 38 age group with 23 cases, decreasing in older groups. Hyperopia is rare in younger age groups but rises significantly with age, showing 22 cases in 39 to 48, 18 in 49 to 58, and 6 in over 59. This pattern indicates normal vision is common among the young, while farsightedness increases with age.

Ocular Abnormalities

Table 5 shows ocular abnormalities among brass industry workers, which revealed that 62.39% had normal vision

Table 3: Distribution of visual impairment

Visual impairment (WHO Criteria)	*Frequency (N)*	*Percentage (%)*
No VI	322	91.73
Moderate VI	24	6.84
SVI	5	1.42

(emmetropia), while 23.36% suffered from myopia, 14.25% from hypermetropia, and 48.72% from presbyopia. Lid-related issues were rare, with ptosis and chalazion each affecting 0.28% of workers. Conjunctiva-related conditions included allergic eye disease (2.28%), pterygium (1.42%), and pinguecula (0.85%). Corneal conditions were corneal scars (1.42%) and degeneration (5.41%). Lens-related issues were significant, with cataracts in 10.54% of workers, pseudophakia in 0.85%, and aphakia in 0.28%. Additionally, 1.14% had squint, and 2.85% had color vision defects. The findings suggest that while a significant portion of the workforce has normal vision, there is a substantial prevalence of refractive errors, particularly presbyopia and myopia. Additionally, environmental and occupational factors appear to contribute to conjunctival, corneal, and lens-related conditions in brass industry workers.

Use of Personal Protective Equipment (PPE)

The usage of personal protective equipment (PPE) among workers in the brass industry is detailed in Table 6. A small proportion of workers, 21 individuals (5.98%), reported using PPE, whereas the vast majority, 330 workers (94.02%), did not use any form of PPE.

Among those who used PPE, the types of equipment varied. Only 1 worker (4.76%) used black goggles, while plain goggles and protective goggles were each used by 10 workers (47.62% for each type), making up the total of 21 workers using PPE.

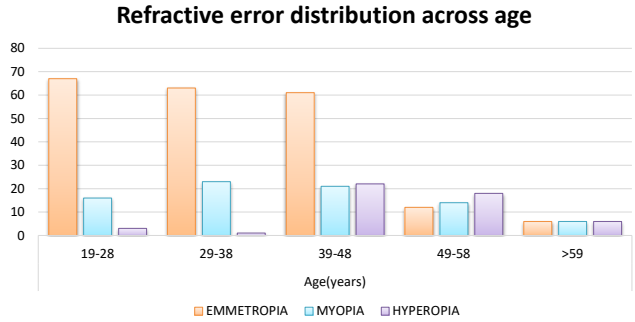
Discussion

The current study was conducted as an initial exploratory investigation of the visual status of brass workers in Moradabad, Uttar Pradesh, India. The mean age of brass workers in our study is 38.5 years, which is slightly higher than the studies done on ocular morbidity in industrial workers, leather tannery workers and petroleum industry workers, which reported 35.3, 34.05 and 35.40 years, respectively, as mean age.[15-17] The greater mean age gives a hint of an aging workforce and may be due to the fact that the primary occupation of men involved is brass in the Moradabad district. So, brass is a lifetime career for the majority of them in the Moradabad district. The findings underscore the high prevalence of VI, notably 8.26% of the workers exhibited some form of VI, with refractive error and cataract being the primary causes. The VI reported in our study is quite high compared to previous research in similar industrial settings, which reported 6.3 and 4.1%, respectively.[7-8] The prevalence of VI in this study is notable given the demographic characteristics of the workers. Most

Table 4: Distribution of Visually Impaired Workers by Nature of Work

Category of VI	*n*	*Gender (M/F)*	*Lat*	*Pac*	*BRep*	*Cas*	*Emb*	*Emr*	*Eng*	*Mol*	*Pol*	*RCre*	*Scr*	*Wel*
Moderate VI	24	23/1	1	1	1	2	1	2	2	1	2	3	7	1
Severe VI	5	4/0	-	-	-	-	1	-	1	-	2	-	1	-
Total	29	27/1	1	1	1	2	2	2	3	1	4	3	8	1
Colour Blind	10	10/0	-	1	-	1	1	-	-	-	-	1	4	2

Lat: Lathing; Pac: Packing; BRep: Brass repairing; Cas: Casting; Emb: Embossing; Emr: Embroidery; Eng: Engraving; Mol: Moulding; Pol: Polishing; RCre: Ring creation; Scr: Scrapping; Wel: Welding;



Graph 1: Proportion of refractive error according to age groups

Table 5: Shows the distributions of ocular abnormalities in brass industry

	Diagnosis	*Frequency (N)*	*Percentage (%)*
	Emmetropia	219	62.39
	Myopia	82	23.36
	Hypermetropia	50	14.25
	Presbyopia	171	48.72
Lids related	Ptosis	1	0.28
	Chalazion	1	0.28
Conjunctiva related	Allergic eye disease	8	2.28
	Pterygium	5	1.42
	Pinguecula	3	0.85
Cornea related	Corneal scar	5	1.42
	Corneal degeneration	19	5.41
	Cataract	37	10.54
Lens related	Pseudophakia	3	0.85
	Aphakia	1	0.28
Other	Squint	4	1.14
	Color vision defect	10	2.85

Table 6: Shows workers using PPE:

		Frequency (N)	*Percentage (%)*
PPE using	Yes	21	5.98
	NO	330	94.02
Type of PPE	Black goggles	1	4.76
	Plain goggles	10	47.62
	Protective goggles	10	47.62
	Total	21	100

of the study participants were middle-aged, with a substantial portion falling within the 39 to 48-year age range. The study observed a significant correlation between age and refractive errors, with a high prevalence of myopia, 23.36%. Refractive error combined (myopia and hypermetropia) reported was 37.6%, which is higher than a study done on rubber industry, chemical and fertilizer, ship building and mine industry workers, which reported 12.4, 14.7 and 17.6% refractive error, respectively.[8] While refractive errors generally stabilize in adulthood,[18] our findings suggest that occupational factors, such as prolonged near work, exposure to metal dust, and uncorrected presbyopia, may contribute to changes in refractive status. Previous studies have indicated that early nuclear sclerosis and lenticular myopia can develop due to environmental influences, particularly in industrial settings.[19,20] Therefore, the observed shifts in refractive error are likely due to a combination of occupational and early age-related changes. High prevalence of uncorrected refractive errors suggests a lack of eyecare seeking behavior, which is further supported by the fact that of 132 workers found to have refractive error, only 10 workers were wearing their glasses. Uncorrected presbyopia was observed in 49% of the workers, which is lower than the previous study on metal machinery (small scale) industries, which reported 65% prevalence of uncorrected presbyopia.[21] The majority of the workers represent themselves at work without their glasses. Out of 171, only 4 were wearing their glasses. Not wearing presbyopic addition glasses can be detrimental to overall productivity. The impact of uncorrected presbyopia on occupational efficiency and safety in an industrial setting is concerning. Workers with uncorrected presbyopia experience difficulty in performing tasks that require precise near vision, increasing the risk of errors, accidents, and loss of productivity.[22] The study also highlights the limited use of personal protective equipment (PPE) among workers, with only 5.98% reporting regular use of any form of eye protection, which is consistent with the findings of a previous study.[15] This low utilization rate of PPE is alarming, considering the known benefits of protective eyewear in preventing occupational eye injuries.[23] Although none of the ocular conditions identified in this study are directly caused by chemical exposure, prolonged

occupational exposure to metal dust, UV radiation, and fine particulate matter can contribute to ocular surface conditions and visual fatigue. Protective eyewear can help mitigate these risks, especially for workers engaged in high-exposure tasks such as welding, polishing, and engraving. The low PPE utilization rate in our study highlights the need for increased awareness and accessibility to protective equipment in the brass industry. Strengthening occupational safety measures could significantly reduce preventable eye injuries and long-term visual impairment among these workers.

Additionally, the study observed various ocular abnormalities among the workers. Cataracts were notably prevalent, affecting 10.54% of the study population. This prevalence is higher than that reported among workers in the chemical (5.29%) and mining (7.4%) industries.[24,25] However, studies on welders and salt workers have reported even higher prevalence rates of 14.44% and 25.38%, respectively.[26,27] The lower cataract prevalence in our study may be due to a relatively healthier workforce and selection bias. Additionally, differences in cataract definition and grading across studies may account for discrepancies.[28] Pterygium was found in 1.42% workers, which is surprisingly much lower than reported by previous studies.[29,30] Color vision abnormalities (2.84%) found in our study are lower than the 10.8% reported in small-scale and tiny sector industries in Ambattur Industrial Estate, Chennai, India, but are similar to the 2% reported in small-scale and tiny sector metal machinery industries.[7,22] All individuals identified with color vision defectiveness were male. These color vision-deficient workers were primarily engaged in tasks such as packing (n=1), casting (n=1), embossing (n=1), polishing (n=1), scraping (n=4), and welding (n=2). No color vision defect workers were found in lathing, brass repairing, embroidery, engraving, molding, or ring creating. Defective color vision can reduce work efficiency and increase the risk of workplace accidents. Therefore, future research should focus on the impact of color vision defectiveness on the functioning of industry workers.

Despite these significant findings, the study has several limitations. The cross-sectional design provides a snapshot of the ocular health status of workers at a single point in time, which may not capture the progression of VI and ocular disorders over time. Additionally, the reliance on self-reported data for PPE usage may introduce reporting bias. Future longitudinal studies are needed to establish causal relationships between occupational exposures and ocular health outcomes and to evaluate the effectiveness of interventions aimed at improving eye health in this population.

Conclusion

The study reveals significant ocular health issues among brass industry workers in Moradabad, highlighting a high prevalence of visual impairment, uncorrected refractive errors, and uncorrected presbyopia. The findings emphasize the urgent need for regular vision screening, the provision of affordable corrective eyewear, and the implementation of comprehensive eye care services. Additionally, the low usage of personal protective equipment calls for increased awareness and accessibility to enhance worker safety. Addressing these concerns can substantially improve the ocular health, safety, and overall productivity of workers in the brass industry. Future research should focus on longitudinal studies to better understand the progression of ocular disorders and the effectiveness of preventive interventions.

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Review Article

When the Choroid Speaks First: Choroidal Metastasis

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Abstract

Choroid is the most common intraocular metastatic site, presenting typically as yellow subretinal/choroidal lesions with rapid symptom onset and associated subretinal fluid. Breast and Lung primaries dominate etiologies, and ocular disease may occur even when systemic disease is under treatment. Multimodal imaging (fundus examination, ultrasonography, OCT ± angiography) guides diagnosis and response assessment. Management is individualized: systemic therapy is preferred when the disease is chemosensitive or treatment is being escalated; local therapies (external beam radiotherapy, plaque radiotherapy, photodynamic therapy, transpupillary thermotherapy, and intravitreal anti-VEGF) are considered for vision-threatening lesions, poor systemic control, or inadequate ocular response. In chemotherapy-treated cancers, a unilateral choroidal metastasis should prompt coordinated ocular-oncology care aimed at preserving vision while respecting systemic prognosis and treatment timelines. Early imaging-based diagnosis and timely local therapy can provide meaningful visual benefit.

Keywords: Choroid, Chemotherapy, Lung carcinoma, Breast carcinoma, Metastasis.

Introduction

Choroidal metastasis (CM) is the most frequent form of intraocular metastasis because the choroid offers rich vascularity and a favourable microenvironment for hematogenous spread.[1,2] While many patients have known systemic malignancy, ocular symptoms can be the first clue—or may appear during ongoing systemic therapy, including chemotherapy.[3,4] For an ophthalmologist, the key challenge is to recognize the lesion quickly, confirm it with appropriate imaging, and coordinate management in a way that protects vision without disrupting oncology care.[4,5]

Clinical Vignette

A patient with known lung carcinoma on chemotherapy presents with recent, unilateral blurring of vision and metamorphopsia. Dilated fundus exam shows a solitary, yellow choroidal lesion in the posterior pole with subretinal fluid (Figure 1), which strongly suggests unilateral CM, requiring systemic correlation and a shared ocular-oncology plan.[3,5]

Epidemiology and Primary Tumour Profile

Historical clinicopathologic work has established that ocular metastasis is not rare in advanced systemic cancer, and that the eye/orbit may be involved even when systemic disease is not widespread.[1,2] In large clinical series of uveal metastases, choroid remains the predominant uveal site, and many eyes have a single lesion, though multifocal disease also occurs.[3] Across studies and reviews, the most common primary tumours reported are breast and lung cancers (Table 1).[2,4,5]

Pathobiology (Why The Choroid?)

As proposed by Paget's "Seed and Soil" theory, the tumour cells ("Seed") can grow only in a suitable microenvironment ("Soil"). Metastasis to the choroid is largely hematogenous; the posterior ciliary circulation and the highly dedicated choroidal blood flow facilitate tumour embolization, making it a fertile "Seed-bed".[5] The resulting lesion typically grows and secondarily affects the RPE and neurosensory retina, producing subretinal fluid, photoreceptor dysfunction, and

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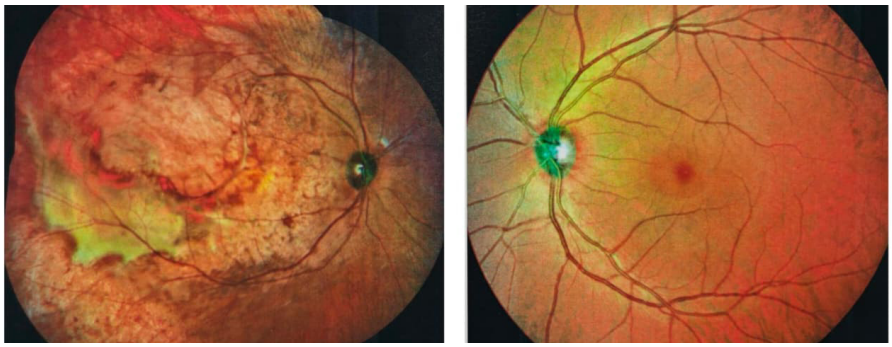

Figure 1: Fundus photograph showing unilateral choroidal metastasis in a patient of lung carcinoma on chemotherapy

rapid visual symptoms—often out of proportion to the apparent lesion size.[4,5]

Clinical Presentation

Common symptoms include painless decreased vision, metamorphopsia, photopsia, and scotoma.[4] On examination, classic features include:

Table 1: Suspected primary tumour loci for choroidal metastasis, in decreasing order of frequency

S. No.	*Primary tumour site*	*Occurrence (%)*
1.	Breast	40–53
2.	Lung	20–29
3.	GI Tract	4
4.	Prostate	2
5.	Kidney	2
6.	Cutaneous	2
7.	Rare (Salivary Glands, Thyroid, Testes, Female Genito-Urinary Tract, Neuro-Endocrine Tumours, Sarcomas)	~8

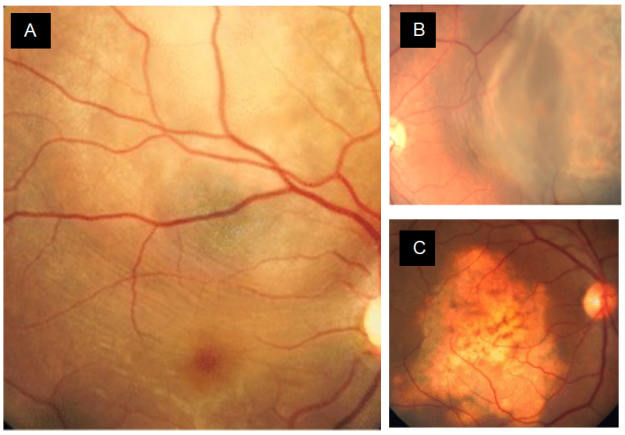

Figure 2: (A) Choroidal metastasis superotemporal to the disc, with serous detachment involving the macula (B) Choroidal metastasis involving the macula, extending beyond the equator with associated serous retinal detachment (C) Large choroidal mass with leopard skin pigmentation in the periphery

- Creamy-yellow, amelanotic choroidal mass (flat, plateau, or slightly dome-shaped)
- Subretinal fluid/serous retinal detachment (Figure 2A, B).

Possible RPE mottling, "leopard spotting," or overlying changes in chronic lesions (Figure 2C).[4,5]

Although not a rule, the colour appearance may give a clue towards the possible primary site of metastasis, as listed in Table 2.[5]

Multimodal imaging approach

Ultrasonography (B-scan/A-scan)

USG (A scans+ B Scans) constitute an important diagnostic tool for CM, which often show moderate-to-high internal reflectivity on A-scan and a plateau/lobulated configuration on B-scan (as opposed to the classically low-to-medium reflectivity of many melanomas).[3,5]

OCT (Essential for Diagnosis and Follow-up)

OCT is an essential investigation in our armamentarium for documentation at the time of presentation as well as during follow-up. It typically demonstrates subretinal fluid, RPE undulations, "lumpy-bumpy" contour, and outer retinal disruption.[5] It is extremely useful for monitoring response after systemic therapy or radiotherapy, because visual symptoms often correlate with fluid dynamics better than the bulk of the tumour.[5]

Angiography (FFA/ICGA) and OCTA

Angiographic patterns can support diagnosis and help rule out mimics; however, in many clinical settings, Fundus + Ultrasound + OCT is sufficient to justify a systemic correlation and treatment planning.[4,5]

Differential Diagnosis

- Amelanotic choroidal melanoma
- Choroidal haemangioma
- Posterior scleritis
- Choroidal granuloma (TB/sarcoid)
- AMD-related lesions (PED, fibrovascular complex)
- Lymphoma and other infiltrative disorders[4,5]

A short timeline, systemic cancer history, creamy-yellow lesion, and significant subretinal fluid favour metastasis.[4,5]

Table 2: The likely colour changes seen in Choroidal Metastasis from various primary tumour loci are listed in Table 1

S. No.	*Primary*	*Clinical feature*
1.	Breast	Creamy-white
2.	Lung	Pale yellow
3.	Carcinoid (including GI Tract)	Orange
4.	Prostate	Amelanotic
5.	Kidney	Orange
6.	Melanoma (including Cutaneous, Mucosal, or Uveal)	Dark brown
7.	Thyroid	Orange

Systemic Evaluation and Coordination with Oncology

Once CM is suspected, the ophthalmologist's role is to:

- Document ocular baseline (VA, Fundus photos, OCT, Ultrasound).[4,5]
- Communicate promptly with the oncologist ocular disease can reflect systemic progression, treatment resistance, or a need for regimen change.[4,6]
- Consider whether tissue confirmation is needed. In a patient with known lung carcinoma and classic ocular features, biopsy is often unnecessary; however, atypical lesions or unknown primary may require further work-up.[4,5]

Management Options

Treatment is multidisciplinary and is individualized based on visual threat, systemic status, expected survival, number/location of lesions, and response to systemic therapy.[4,7]

Systemic therapy

If the patient is already receiving chemotherapy (or targeted therapy/immunotherapy), ocular lesions may regress with systemic control.[5,7] Contemporary cancer cohorts highlight that CM may accompany advanced disease, yet ocular symptom-driven diagnosis is common, reinforcing the need for ophthalmology-oncology linkage.[6]

External beam radio therapy (EBRT)

EBRT remains a standard local option for vision-threatening lesions or inadequate response to systemic therapy, often achieving tumour regression and fluid resolution.[7,8] It is particularly useful for posterior pole lesions where rapid functional improvement is desired.

Plaque brachytherapy/focal radiotherapy

When a focal approach is preferred (single lesion, limited field), plaque therapy can be considered based on institutional experience and logistics.[7]

Intravitreal anti-VEGF (Adjunct)

Anti-VEGF can reduce exudation and sometimes tumour thickness in selected cases, especially when subretinal fluid is a major driver of visual loss.[9,11] It is commonly used as an adjunct to radiotherapy or when systemic therapy is ongoing, but ocular response is slow.[8,11]

PDT/TTT (Selected, Small, Accessible lesions)

Transpupillary thermotherapy (TTT) and photodynamic therapy (PDT) have been described in select cases and small series, generally as focal options for smaller lesions or when other modalities are not feasible.[12] The choice depends on lesion size, location, and available expertise.

Prognosis

Visual prognosis depends on macular involvement, the amount/duration of subretinal fluid, and response to therapy.[4,5] Systemic prognosis is primarily driven by the underlying malignancy stage and treatment responsiveness; CM generally indicates advanced disease, although modern systemic therapies can meaningfully extend survival in selected subsets.[6,7]

Conclusion

CM in a patient with carcinoma even while on chemotherapy should be treated as a time-sensitive, vision-threatening event. A pragmatic approach uses Fundus examination, OCT, and Ultrasonography to support diagnosis, rapidly informs oncology colleagues, and selects between systemic therapy optimization and local control (often EBRT ± intravitreal anti-VEGF) based on ocular urgency and systemic realities.[3,8] With coordinated care, many patients gain stabilisation of vision and symptomatic relief, aligning eye care with overall cancer management goals.[4,7]

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Review Article

Lacrimal Gland and Drainage Disorders in the Era of Immune-Mediated Disease: A Systematic Review of Pathophysiology, Multimodal Imaging, and Precision Management

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Abstract

Background: Lacrimal gland and lacrimal drainage disorders encompass a broad spectrum of inflammatory conditions. Advances in immunology, imaging, and pathology have increasingly identified these disorders as predominantly immune-mediated, with IgG4-related disease emerging as a major etiologic entity. However, evidence remains dispersed across specialties, limiting integrated clinical application.

Objective: To systematically review and synthesize current evidence on the pathophysiology, multimodal imaging features, and precision-based management of immune-mediated lacrimal gland and lacrimal drainage disorders.

Methods: This systematic review was conducted in accordance with PRISMA 2020 guidelines. PubMed/MEDLINE, EMBASE, Scopus, and Web of Science were searched for studies published between January 2000 and June 2025. Eligible studies addressed immune-mediated lacrimal disease with emphasis on diagnostic approaches, imaging characteristics, histopathology, and management. Data were synthesized qualitatively across predefined domains.

Results: About 93 studies met the inclusion criteria. IgG4-related disease was the most frequently reported immune-mediated lacrimal disorder, followed by Sjögren's syndrome and idiopathic orbital inflammatory disease. Multimodal imaging, particularly MRI and CT, was central to disease characterization, with ultrasound elastography and functional imaging increasingly contributing to diagnostic stratification. Systemic corticosteroids were the most common first-line therapy; however, high relapse rates, especially in IgG4-related disease, prompted growing use of steroid-sparing immunosuppressive agents and biologic therapies, most notably rituximab. Surgical and endoscopic interventions were selectively employed for diagnostic confirmation and refractory lacrimal drainage obstruction. Short-term responses were generally favorable, while long-term outcomes remained heterogeneous.

Conclusion: Immune-mediated mechanisms represent a dominant paradigm in lacrimal disease. Optimal diagnosis and management require an integrated, multimodal, precision-based approach, combining clinical evaluation, advanced imaging, histopathology, and individualized therapy.

Keywords: Immune-mediated lacrimal disease, IgG4-related disease, Dacryoadenitis, Lacrimal drainage disorders, Multimodal imaging, Precision medicine, Systematic review.

Introduction

Disorders of the lacrimal gland and lacrimal drainage system represent a heterogeneous group of conditions that range from acute infectious and inflammatory processes to chronic fibroinflammatory and neoplastic diseases. Traditionally, lacrimal pathology was approached using broad clinicopathologic classifications such as acute versus chronic dacryoadenitis or obstructive versus non-obstructive lacrimal drainage disorders. However, over the past two decades, advances in immunology, pathology, and imaging have profoundly reshaped the understanding of lacrimal

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disease, particularly with the recognition of immune-mediated entities as dominant contributors to chronic lacrimal gland dysfunction.[1-3]

Among these, immunoglobulin G4–related disease (IgG4-RD) has emerged as a pivotal systemic fibroinflammatory disorder with a marked predilection for the lacrimal glands and orbital adnexa. IgG4-related dacryoadenitis, frequently presenting as painless bilateral lacrimal gland enlargement, is now recognized as part of a multisystem disease spectrum that also involves the salivary glands, pancreas, kidneys, lymph nodes, and retroperitoneum.[2,4] Histopathologically, the disease is characterized by dense lymphoplasmacytic infiltration, storiform fibrosis, and obliterative phlebitis, with increased IgG4-positive plasma cells forming the cornerstone of diagnosis.[5]

Beyond IgG4-RD, other immune-mediated conditions such as Sjögren's syndrome, idiopathic orbital inflammatory disease, sarcoidosis, and granulomatosis with polyangiitis also frequently involve the lacrimal gland and drainage apparatus, often producing overlapping clinical and radiologic features.[6,7] These disorders share common pathogenic pathways involving dysregulated T-helper cell subsets, B-cell activation, and cytokine-driven fibrosis, underscoring the need for an integrated immunopathogenic framework when evaluating lacrimal disease.[8]

The evolution of multimodal imaging has played a crucial role in refining diagnostic accuracy. High-resolution computed tomography (CT) and magnetic resonance imaging (MRI) provide detailed anatomic and tissue-characterization insights that help distinguish inflammatory, infiltrative, and neoplastic lacrimal gland lesions.[9,10] In immune-mediated disease, imaging often demonstrates diffuse glandular enlargement, homogenous enhancement, and associated extra-lacrimal involvement, features that may guide targeted biopsy and reduce diagnostic delay.[11] Furthermore, pattern-based radiologic approaches and functional imaging techniques have improved differentiation between IgG4-related disease and its mimics, including lymphoma and idiopathic inflammation.[12]

Parallel to diagnostic advances, management strategies for lacrimal disease have shifted toward precision medicine. Corticosteroids remain first-line therapy for many immune-mediated lacrimal disorders; however, high relapse rates and treatment-related morbidity have driven the adoption of steroid-sparing agents, including conventional immunosuppressants and targeted biologic therapies such as rituximab.[4,13] In lacrimal drainage disorders, minimally invasive endoscopic and image-guided surgical techniques are increasingly integrated with systemic disease control, reflecting a multidisciplinary approach involving ophthalmology, rheumatology, radiology, and pathology.[14]

Despite the growing body of literature, existing reviews often focus narrowly on single disease entities or isolated aspects such as pathology or imaging. A comprehensive synthesis integrating pathophysiology, multimodal imaging, and precision management across lacrimal gland and drainage disorders remains lacking. This systematic review aims to address this gap by critically evaluating current evidence to provide a unified, clinically applicable framework for the diagnosis and management of immune-mediated lacrimal disease in contemporary practice.

Methods

Study Design and Reporting Standards

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines, ensuring methodological transparency, reproducibility, and completeness of reporting.[15] The review protocol was prospectively developed to clearly define the study objectives, eligibility criteria, search strategy, and data synthesis methods, in line with contemporary standards for evidence synthesis in ophthalmology and immune-mediated disease research.[16,17] The systematic literature search identified a total of 1,332 records, comprising 1,254 records retrieved from electronic databases and 78 records identified through additional sources. After removal of duplicates, 1,120 records remained and were screened based on titles and abstracts. Of these, 845 records were excluded due to irrelevance to lacrimal gland or lacrimal drainage disorders, non–immune-mediated etiologies, or non-original study designs. The remaining 275 articles underwent full-text assessment for eligibility. Following detailed evaluation, 182 full-text articles were excluded for predefined reasons, including non-human studies, lack of immune-mediated focus, insufficient relevance to imaging or management, or inclusion of case series with fewer than three patients. Ultimately, 93 studies met the inclusion criteria and were included in the qualitative synthesis.

Eligibility Criteria

Studies were selected based on the Population, Intervention, Comparison, Outcomes, and Study design (PICOS) framework.[15]

Inclusion Criteria

- Original research articles, systematic reviews, or meta-analyses
- Studies involving lacrimal gland or lacrimal drainage system disorders
- Explicit focus on immune-mediated etiologies, including but not limited to IgG4-related disease, Sjögren's syndrome, idiopathic orbital inflammation, sarcoidosis, or vasculitis
- Use of multimodal imaging (CT, MRI, ultrasound, scintigraphy, or endoscopy) and/or medical or surgical management strategies
- Human studies published in peer-reviewed journals
- Articles published in English

Exclusion Criteria

- Isolated infectious dacryoadenitis without immune involvement
- Purely neoplastic lacrimal tumors without an inflammatory context
- Case reports with fewer than three patients (unless part of larger reviews)
- Conference abstracts, editorials, and non-peer-reviewed literature

These criteria align with prior systematic reviews evaluating lacrimal imaging and immune-mediated ocular disease.

Information Sources and Search Strategy

A comprehensive literature search was conducted across four electronic databases: PubMed/MEDLINE, EMBASE, Scopus, and Web of Science. The search encompassed studies published between January 2000 and June 2025, reflecting the period during which immune-mediated lacrimal disorders, particularly IgG4-related disease, have been increasingly recognized and characterized. The search strategy combined controlled vocabulary terms (Medical Subject Headings [MeSH]) with free-text keywords, including *"lacrimal gland," "dacryoadenitis," "lacrimal drainage system,"* and *"nasolacrimal duct,"* in conjunction with *"immune-mediated," "IgG4-related disease," "Sjögren's syndrome,"* and *"orbital inflammatory disease,"* as well as terms related to *imaging* and *management* (e.g., *MRI, CT, ultrasound, treatment*). Reference lists of all included studies and relevant review articles were manually screened to identify additional eligible publications, in accordance with PRISMA 2020 recommendations.

Study Selection Process

All records identified through the database searches and additional sources were imported into reference management software, where duplicate citations were systematically identified and removed. The remaining records were subjected to a two-stage screening process. First, two reviewers independently screened titles and abstracts to assess preliminary eligibility based on the predefined inclusion and exclusion criteria. Articles deemed potentially relevant were then retrieved for full-text evaluation, which was performed independently by the same reviewers to determine final eligibility. Any discrepancies arising during either the screening or full-text assessment stages were resolved through discussion and consensus; when consensus could not be reached, a third reviewer was consulted to adjudicate. The entire study selection process was rigorously documented and is presented in a PRISMA flow diagram, detailing the number of records identified, screened, excluded (with reasons), and ultimately included in the final qualitative synthesis.

The diagram illustrates the process of identification, screening, eligibility assessment, and inclusion of studies in accordance with the PRISMA 2020 guidelines. A total of 1,332 records were identified through database searching and other sources. After duplicate removal and screening,

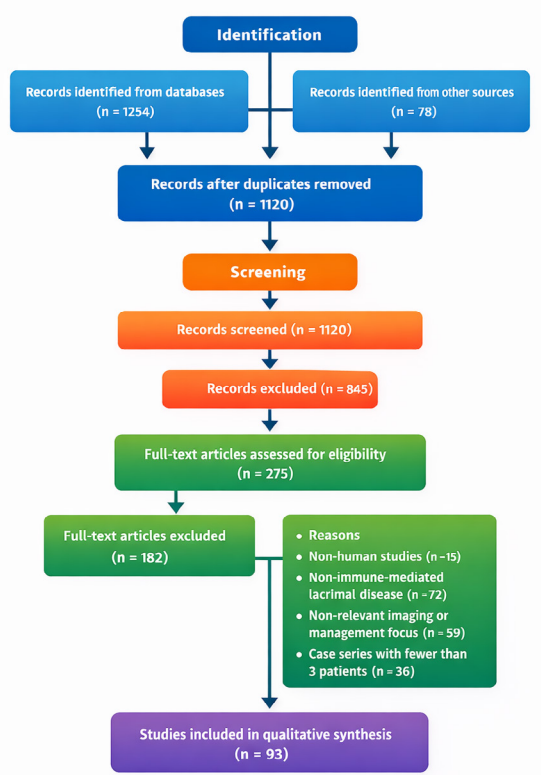

Figure 1: PRISMA flow diagram of study selection

275 full-text articles were assessed for eligibility. Of these, 182 were excluded for predefined reasons, resulting in 93 studies included in the final qualitative synthesis focusing on immune-mediated lacrimal gland and lacrimal drainage disorders.

Data Extraction

Data extraction was performed independently by two reviewers using a standardized and pilot-tested data extraction form to ensure consistency and accuracy. The extracted variables included study characteristics (first author, year of publication, country of origin, and study design), patient demographics and sample size, and the underlying immune-mediated diagnosis. Detailed information regarding lacrimal gland and/or lacrimal drainage system involvement was recorded, along with the imaging modalities employed and their corresponding radiologic features. Additional extracted data included histopathological findings, medical and surgical management strategies, and reported clinical outcomes, including duration of follow-up, where available. Any discrepancies in data extraction were resolved through discussion and consensus. This systematic approach is consistent with methodologies employed in prior lacrimal and orbital systematic reviews, ensuring methodological rigor and comparability of findings across studies.

Risk of Bias and Quality Assessment

The methodological quality and risk of bias of the included studies were assessed using validated tools appropriate to

each study design. Observational studies were evaluated using the Newcastle–Ottawa Scale (NOS), while systematic reviews were appraised using the AMSTAR-2 instrument. Based on these assessments, each study was categorized as having a low, moderate, or high risk of bias. Quality appraisal was performed independently by two reviewers, and any discrepancies were resolved through discussion and consensus. This structured and rigorous assessment was essential for interpreting heterogeneity across studies and for evaluating the overall strength and reliability of the evidence related to immune-mediated lacrimal gland and lacrimal drainage disorders.[18,19]

Data Synthesis

Given the substantial heterogeneity in study designs, imaging modalities, outcome measures, and reporting standards, a qualitative narrative synthesis was undertaken. The findings were systematically synthesized across three predefined domains: (1) pathophysiology and immunologic mechanisms, (2) multimodal imaging characteristics, and (3) precision management strategies. Where appropriate, results were further stratified according to specific disease entities (e.g., IgG4-related disease versus Sjögren's syndrome) and anatomical involvement (lacrimal gland versus lacrimal drainage system), in order to facilitate clinically meaningful comparisons. A quantitative meta-analysis was not performed due to the marked clinical and methodological heterogeneity among included studies, including variability in diagnostic criteria, imaging protocols, therapeutic interventions, and outcome reporting, which precluded meaningful statistical pooling of data. This structured approach follows best practices in ophthalmic systematic reviews and allows for comprehensive integration of diverse evidence while accounting for variability across studies.

Results

Study Selection

The systematic search and study selection process is summarized in the PRISMA flow diagram (Figure 1). A total of 1,332 records were identified through database searching and additional sources. After removal of duplicates, 1,120 records underwent title and abstract screening, of which 845 were excluded. Full-text assessment was performed for 275 articles, resulting in the exclusion of 182 studies for predefined reasons. Ultimately, 93 studies were included in the qualitative synthesis.

Characteristics of Included Studies

The characteristics of the included studies are summarized in Table 1. The 93 studies were published between 2001 and 2025, reflecting the growing recognition of immune-mediated lacrimal disease over the past two decades. Study designs included retrospective observational studies (n ≈ 52), prospective cohort studies (n ≈ 18), cross-sectional imaging studies (n ≈ 11), and systematic reviews (n ≈ 12). The majority of studies originated from Asia, Europe, and North America, with notable contributions from Japan, China, the United States, and the United Kingdom. Sample sizes varied widely, ranging from small cohorts of fewer than 20 patients to multicenter studies involving more than 200 participants. Most studies focused on adult populations, although a limited number included pediatric patients, particularly in studies addressing congenital or inflammatory lacrimal drainage disorders.

Spectrum of Immune-Mediated Lacrimal Disorders

The distribution of immune-mediated diagnoses is presented in Table 2. IgG4-related disease (IgG4-RD) was the most frequently reported entity, accounting for approximately 40–45% of included studies. Sjögren's syndrome was the second most common diagnosis, followed by idiopathic orbital inflammatory disease, sarcoidosis, and granulomatosis with polyangiitis. Several studies reported overlapping diagnoses or compared IgG4-RD with other inflammatory or lymphoproliferative conditions. Lacrimal gland involvement predominated across most disease entities, while isolated lacrimal drainage system involvement was less frequently reported and often associated with chronic inflammatory or fibrotic disease.

The distribution of immune-mediated lacrimal disorders across the included studies is illustrated in Figure 2. IgG4-related disease was the most frequently reported diagnosis, accounting for approximately 43% of studies, underscoring its central role in contemporary lacrimal gland pathology. Sjögren's syndrome constituted the second most common entity (~23%), reflecting its well-established association with chronic lacrimal gland dysfunction. Idiopathic orbital inflammatory disease represented approximately 14% of studies, while sarcoidosis (~8%) and vasculitic disorders,

Table 1: General characteristics of included studies

Characteristic	*Findings*
Total studies included	93
Publication years	2001–2025
Study designs	Retrospective cohorts, prospective cohorts, cross-sectional studies, and systematic reviews
Geographic distribution	Asia, Europe, North America
Population	Predominantly adults
Primary focus	Immune-mediated lacrimal gland ± drainage disorders

Table 2: Immune-mediated diagnoses reported in included studies

Diagnosis	*Approximate proportion of studies*
IgG4-related disease	40–45%
Sjögren's syndrome	20–25%
Idiopathic orbital inflammatory disease	10–15%
Sarcoidosis	5–10%
Granulomatosis with polyangiitis/vasculitis	<5%
Mixed/comparative inflammatory conditions	Remaining

including granulomatosis with polyangiitis (~4%), were less frequently reported. The remaining 8% comprised other immune-mediated inflammatory conditions. This distribution highlights the predominance of IgG4-related disease in the current literature and emphasizes the evolving focus on systemic immune-mediated mechanisms in lacrimal disorders.

Bar chart illustrating the relative proportion of immune-mediated diagnoses reported among the 93 included studies. IgG4-related disease represents the most frequently reported entity, followed by Sjögren's syndrome and idiopathic orbital inflammatory disease. Less commonly reported conditions include sarcoidosis, granulomatosis with polyangiitis and other vasculitides, and miscellaneous immune-mediated inflammatory disorders. Percentages reflect the approximate proportion of studies addressing each diagnostic category.

Anatomical Involvement

Across the included studies, lacrimal gland involvement was reported in the majority of cases, either as isolated dacryoadenitis or as part of multisystem disease. Bilateral lacrimal gland involvement was frequently described in IgG4-related disease and Sjögren's syndrome, whereas unilateral involvement was more commonly associated with idiopathic inflammatory disease. In contrast, lacrimal drainage system involvement (including the lacrimal sac and nasolacrimal duct) was less frequently reported and was typically associated with chronic inflammation, fibrosis, or secondary obstruction. Combined lacrimal gland and drainage system involvement was reported in a subset of studies, particularly in advanced immune-mediated disease.

Multimodal Imaging Findings

Imaging characteristics are summarized in Table 3. Magnetic resonance imaging (MRI) and computed tomography (CT) were the most commonly utilized imaging modalities. MRI frequently demonstrated diffuse lacrimal gland enlargement, homogeneous enhancement, and associated orbital or extra-orbital involvement in immune-mediated disease. CT was particularly useful for assessing bony remodeling and extension into adjacent structures. Ultrasound and elastography were increasingly reported in studies of Sjögren's syndrome, showing altered echotexture and increased stiffness of the lacrimal gland. Functional imaging techniques, including lacrimal scintigraphy and dacryoendoscopy, were primarily employed in studies focusing on lacrimal drainage disorders.

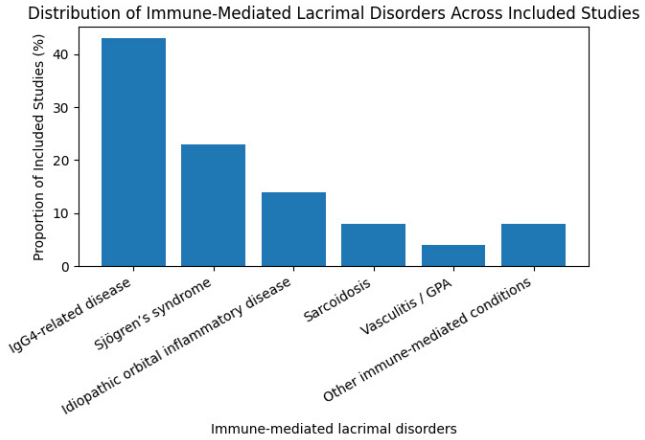

Figure 2: Distribution of immune-mediated lacrimal disorders across included studies

Histopathological Findings

Histopathological confirmation was reported in a substantial proportion of studies, particularly those evaluating IgG4-related disease. Common findings included dense lymphoplasmacytic infiltration, storiform fibrosis, and increased IgG4-positive plasma cells. In Sjögren's syndrome, focal lymphocytic sialadenitis–like features were frequently described. These findings were critical in differentiating immune-mediated disease from neoplastic and idiopathic inflammatory conditions.

Management Strategies and Outcomes

Management strategies varied according to disease entity, severity, and anatomical involvement. Systemic corticosteroids were the most commonly reported first-line therapy across immune-mediated lacrimal disorders. However, several studies reported high relapse rates, particularly in IgG4-related disease, highlighting the limitations of corticosteroid monotherapy. As a result, steroid-sparing immunosuppressive agents and biologic therapies, most notably rituximab, were increasingly utilized and demonstrated favorable outcomes in patients with refractory or recurrent disease. Surgical

Table 3: Imaging modalities and key radiologic features

Imaging modality	*Common findings*
MRI	Diffuse gland enlargement, homogeneous enhancement, orbital extension
CT	Gland enlargement, bony remodeling, structural assessment
Ultrasound / elastography	Altered echotexture, increased stiffness
Scintigraphy	Functional outflow impairment
Dacryoendoscopy	Intraluminal inflammation, fibrosis

interventions were primarily reserved for specific indications, including diagnostic biopsy, management of lacrimal drainage obstruction, or treatment of refractory cases unresponsive to medical therapy. Overall, most studies reported good short-term clinical responses, although long-term outcomes were heterogeneous, emphasizing the need for individualized, precision-based treatment strategies. As summarized in Figure 3, an integrated diagnostic and management pathway was consistently reported across the included studies. Initial evaluation typically combined clinical assessment and laboratory investigations with multimodal imaging to delineate disease extent and anatomical involvement. Histopathological confirmation was frequently employed in cases of diagnostic uncertainty or suspected IgG4-related disease. Management decisions were individualized based on disease severity and site of involvement, with systemic medical therapy serving as first-line treatment in most immune-mediated conditions, while surgical or endoscopic interventions were reserved for diagnostic purposes or refractory lacrimal drainage obstruction. This precision-based, multidisciplinary approach reflects contemporary best practice in the management of immune-mediated lacrimal disease.

Schematic illustration of an integrated diagnostic and management approach for immune-mediated lacrimal gland and lacrimal drainage disorders. Initial clinical and laboratory evaluation is complemented by multimodal imaging and histopathological confirmation, where indicated. Therapeutic strategies are individualized and may include systemic medical therapy or surgical and endoscopic intervention, reflecting a precision-based, multidisciplinary management framework.

Risk of Bias across Studies

Quality assessment revealed low to moderate risk of bias in the majority of included observational studies. Systematic reviews assessed using AMSTAR-2 demonstrated variable methodological quality, with limitations most commonly related to heterogeneity and lack of quantitative synthesis. These findings should be considered when interpreting the strength of evidence presented.

Overall, the results of this systematic review demonstrate that immune-mediated mechanisms represent a dominant and increasingly recognized cause of lacrimal gland and lacrimal drainage disorders, with IgG4-related disease emerging as the most frequently reported entity. Across the included studies, multimodal imaging played a central role in defining disease extent, anatomical involvement, and functional impairment, while histopathological confirmation was essential in selected cases to establish a definitive diagnosis. Management strategies were predominantly medical, with systemic immunosuppression forming the cornerstone of therapy, complemented by targeted biologic agents and selective surgical or endoscopic interventions when indicated. Despite generally favorable short-term responses, variability in long-term outcomes was evident, reflecting heterogeneity in disease behavior and treatment approaches. Collectively, these findings highlight the complexity of immune-mediated lacrimal disease and underscore the need for an integrated, precision-based diagnostic and management framework.

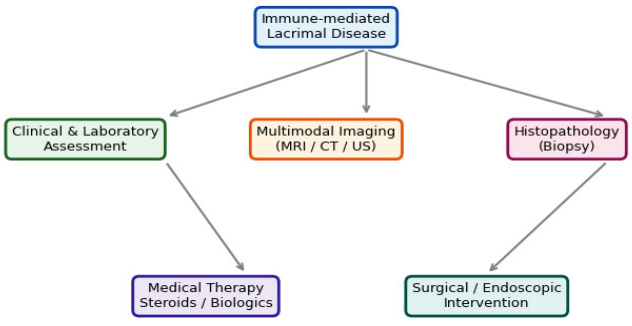

Figure 3: Precision diagnostic and management pathway for immune-mediated lacrimal disease

Discussion

Principal Findings

This systematic review provides an updated synthesis of immune-mediated lacrimal gland and lacrimal drainage disorders, emphasizing evolving concepts in pathophysiology, imaging, and precision-based management. The predominance of IgG4-related disease (IgG4-RD) across included studies confirms its central role in contemporary lacrimal disease, consistent with prior reports describing the lacrimal gland as a frequent site of involvement in systemic IgG4-RD.[20,21] The increasing recognition of immune-mediated mechanisms has shifted diagnostic paradigms from exclusion-based approaches toward integrated, multimodal evaluation strategies incorporating imaging, histopathology, and serology.[22-24]

Pathophysiological Insights and Disease Spectrum

The high prevalence of IgG4-related disease (IgG4-RD) observed in this review reflects significant advances in disease recognition and the refinement of diagnostic criteria over recent years.[25,26] Characteristic histopathological features, including dense lymphoplasmacytic infiltration, storiform fibrosis, and increased numbers of IgG4-positive plasma cells, support the concept of an immune-driven fibroinflammatory process underlying lacrimal gland involvement. Recent advances in tear fluid bioanalysis further enhance the understanding of lacrimal gland pathology in immune-mediated ocular disease. Yadav and colleagues demonstrated that quantitative analysis of tear fluid biomarkers provides clinically meaningful insights into ocular inflammatory and metabolic states, highlighting the lacrimal functional unit as a valuable source of noninvasive diagnostic information.[27] Although their investigation focused on diabetic retinopathy, the methodological framework and biomarker-driven approach have important implications for immune-mediated lacrimal disorders, in which altered tear composition reflects underlying glandular inflammation and immune activation.

Integration of tear-based biomarkers with advanced imaging and histopathological assessment may therefore represent a promising strategy for earlier diagnosis, improved disease stratification, and monitoring of treatment response in immune-mediated lacrimal disease.[28,29] Importantly, overlap with other immune-mediated conditions, particularly Sjögren's syndrome, remains a significant diagnostic challenge, as both entities may present with bilateral lacrimal gland enlargement and chronic inflammatory changes.[30,31] Distinguishing between these disorders is clinically critical, given differences in systemic associations, relapse risk, and therapeutic responsiveness.

Role of Multimodal Imaging

Our findings underscore the central role of multimodal imaging in immune-mediated lacrimal disease. MRI emerged as the most informative modality for soft-tissue characterization and assessment of disease extent, particularly in differentiating inflammatory enlargement from neoplastic processes.[32,33] CT remains valuable for evaluating osseous involvement and guiding surgical planning, especially in cases with lacrimal fossa remodeling or drainage obstruction. Ultrasound and elastography have gained increasing attention as noninvasive tools capable of detecting inflammatory changes and tissue stiffness, particularly in Sjögren's syndrome and IgG4-RD.[34,35] Functional modalities, including lacrimal scintigraphy and dacryoendoscopy, provide complementary information in patients with lacrimal drainage involvement, facilitating targeted intervention.[36] The integration of these modalities reflects a paradigm shift toward imaging-guided precision diagnostics, as summarized in Figure 3.

Management Strategies and Therapeutic Outcomes

Consistent with previous reports, systemic corticosteroids remain the cornerstone of initial therapy for immune-mediated lacrimal disease, often resulting in rapid symptomatic and radiologic improvement.[37] However, high relapse rates, particularly in IgG4-RD, limit their long-term efficacy.[38] The growing use of steroid-sparing immunosuppressive agents and biologic therapies, most notably rituximab, represents a significant advance, with multiple studies demonstrating sustained remission and reduced relapse rates.[39,40] Surgical and endoscopic interventions were primarily reserved for diagnostic biopsy, refractory disease, or management of lacrimal drainage obstruction. The selective use of surgery within a multidisciplinary framework aligns with contemporary precision-based management models.[41,42] Recent evidence further supports the evolving role of adjunctive surgical strategies in refractory lacrimal drainage disorders. Yadav et al. conducted a comparative study evaluating dacryocystorhinostomy (DCR) with canalicular silicone tube intubation and adjunctive Mitomycin-C application in failed cases of chronic dacryocystitis, demonstrating improved surgical success rates and reduced restenosis in revision cases.[43] Their findings highlight the importance of modulating postoperative fibrosis and maintaining canalicular patency, particularly in patients with chronic inflammatory changes. Although their study primarily addressed chronic dacryocystitis rather than immune-mediated lacrimal gland disease, the underlying principle of fibrosis control and luminal preservation has important implications for immune-mediated lacrimal drainage obstruction, where inflammatory-driven scarring may compromise long-term patency. The use of adjunctive antimetabolites and intubation techniques may therefore represent a valuable component of precision-based surgical management in selected refractory cases.

Clinical Implications

The findings of this review highlight several important clinical implications. First, immune-mediated etiologies should be considered early in patients presenting with lacrimal gland enlargement or chronic lacrimal drainage dysfunction. Second, multimodal imaging should be integrated into routine evaluation to guide diagnosis, biopsy decisions, and treatment planning. Finally, individualized therapy, guided by disease severity, anatomical involvement, and relapse risk, is essential for optimizing long-term outcomes.

Limitations

This review has limitations inherent to the included literature, including heterogeneity in study design, diagnostic criteria, imaging protocols, and outcome reporting. The predominance of retrospective studies and the absence of standardized outcome measures limited quantitative synthesis. Additionally, publication bias toward IgG4-RD may have influenced the observed disease distribution.

Future Directions

Future research should prioritize prospective, multicenter studies with standardized diagnostic and imaging protocols. Emerging imaging techniques, biomarker-driven diagnostics, and targeted biologic therapies warrant further investigation. Long-term outcome studies are particularly needed to define optimal treatment duration and relapse prevention strategies in immune-mediated lacrimal disease.

Future research should prioritize prospective, multicenter studies incorporating standardized diagnostic criteria and harmonized imaging protocols to enhance reproducibility and comparability across institutions. Further investigation into emerging imaging techniques, biomarker-driven diagnostics, and targeted biologic therapies is warranted to refine disease stratification and therapeutic precision. In addition, long-term outcome studies are essential to determine optimal treatment duration, identify predictors of relapse, and develop evidence-based relapse prevention strategies in immune-mediated lacrimal disease. As illustrated in Figure 4, the management of immune-mediated lacrimal disorders has evolved toward an integrated, precision-oriented clinical pathway. The model conceptualizes the dynamic interplay among clinical assessment, laboratory evaluation, multimodal

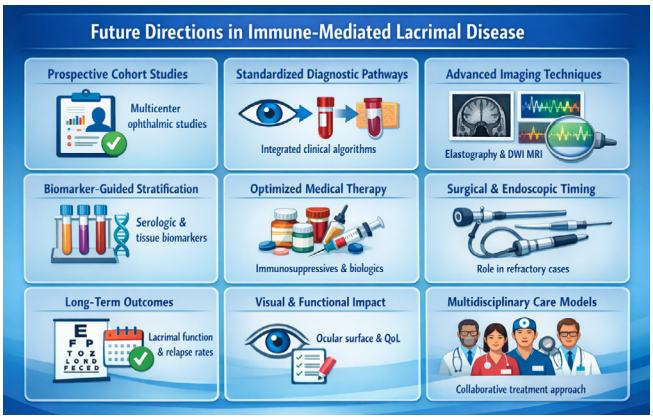

Figure 4: Graphical summary of future research directions in immune-mediated lacrimal disease

imaging, and histopathological confirmation in establishing an accurate and timely diagnosis. Rather than functioning independently, these diagnostic components operate synergistically to delineate disease extent, characterize inflammatory activity, and exclude mimicking conditions such as neoplasia. Importantly, the framework emphasizes individualized therapeutic decision-making, wherein systemic immunomodulatory therapy serves as first-line treatment in most immune-mediated conditions, while surgical or endoscopic intervention is selectively reserved for diagnostic clarification or refractory lacrimal drainage obstruction. This structured approach reflects contemporary multidisciplinary practice and underscores the transition from empiric treatment paradigms to mechanism-driven, stratified management strategies. By integrating structural, functional, and molecular insights, the model presented in Figure 4 reinforces the importance of coordinated care in optimizing both short- and long-term outcomes in immune-mediated lacrimal disorders.

Conclusion

This systematic review highlights a paradigm shift in the understanding of lacrimal gland and lacrimal drainage disorders, demonstrating that immune-mediated disease has become a dominant and clinically significant cause of lacrimal pathology. The predominance of IgG4-related disease reflects improved recognition of immune-driven mechanisms and emphasizes the need to move beyond traditional inflammatory classifications. The evidence synthesized in this review supports a multidisciplinary, precision-based approach to diagnosis, integrating clinical assessment, laboratory evaluation, advanced imaging, and histopathological confirmation when indicated. Multimodal imaging is central to defining disease extent and anatomical involvement, while histopathology remains essential in cases of diagnostic uncertainty, particularly in suspected IgG4-related disease. Therapeutically, although systemic corticosteroids remain the mainstay of initial treatment, high relapse rates, especially in IgG4-related disease, highlight the limitations of conventional therapy. The increasing use of steroid-sparing immunosuppressive agents and biologic therapies, most notably rituximab, represents a significant advance in achieving sustained disease control. Surgical and endoscopic interventions retain a targeted role, primarily for diagnostic purposes and management of refractory lacrimal drainage obstruction. Despite generally favorable short-term outcomes, long-term disease behavior remains heterogeneous, underscoring the importance of individualized treatment strategies and close follow-up. Future prospective studies are needed to establish standardized diagnostic algorithms, optimize treatment duration, and improve long-term outcomes. Collectively, this review provides a comprehensive framework to support improved clinical decision-making and patient-centered care in immune-mediated lacrimal disease.

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Review Article

Global Trends in Eyelid Diseases Over Five Decades (1975–2025): A Systematic Review and Meta-Analysis

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Abstract

Background: Eyelid diseases encompass a wide spectrum of inflammatory, neoplastic, congenital, traumatic, and degenerative conditions that significantly impact ocular function, aesthetics, and quality of life. Over the past five decades, demographic transitions, environmental exposure, lifestyle changes, and advances in diagnostic and therapeutic strategies have altered the global epidemiology of eyelid disorders. However, long-term global trends have not been systematically quantified.

Objective: To evaluate global trends, pooled prevalence, and temporal patterns of eyelid diseases from January 1975 to December 2025 through a systematic review and meta-analysis.

Methods: A comprehensive literature search was conducted across PubMed/MEDLINE, Embase, Scopus, Web of Science, and the Cochrane Library in accordance with PRISMA 2020 guidelines. Observational studies reporting epidemiological or clinical outcomes of eyelid diseases were included. Random-effects meta-analysis was performed to estimate pooled prevalence and incidence, with subgroup analyses based on geographic region, disease category, and decade. Risk of bias was assessed using the Newcastle–Ottawa Scale, and certainty of evidence was graded using the GRADE approach.

Results: A total of 260 studies were included in the qualitative synthesis, with 185 studies eligible for meta-analysis. Inflammatory eyelid disorders were the most prevalent category across all decades, demonstrating a rising trend in recent years. Eyelid malignancies showed a progressive increase in incidence, while degenerative eyelid conditions increased in parallel with population aging. Congenital anomalies and traumatic eyelid injuries exhibited relatively stable or region-specific patterns. Significant geographic and temporal heterogeneity was observed across all disease categories.

Conclusion: This 50-year review article highlights an increasing global burden of eyelid diseases, driven predominantly by inflammatory and age-related conditions, with rising oncologic relevance. The findings underscore the need for standardized disease definitions, region-specific surveillance, and integrated eyelid care to guide clinical practice and public health planning worldwide.

Keywords: Eyelid diseases, Blepharitis, Eyelid tumors, Global trends, Systematic review, Meta-analysis.

Introduction

Eyelid diseases constitute a broad and heterogeneous group of disorders encompassing inflammatory, infectious, degenerative, traumatic, congenital, and neoplastic conditions. Although often perceived as localized periocular problems, eyelid disorders carry significant functional, aesthetic, and psychosocial consequences, including ocular surface

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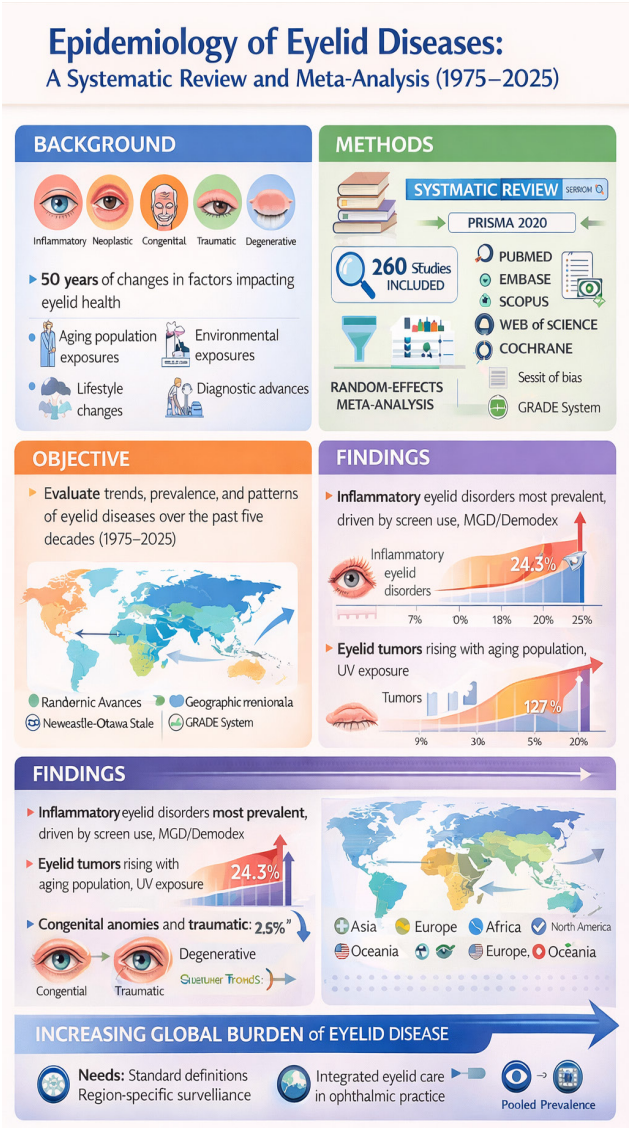


Graphical Abstract: Visual summary of the global epidemiology and temporal trends of eyelid diseases from 1975 to 2025, highlighting pooled prevalence patterns, geographic variation, and the rising burden of inflammatory, neoplastic, and age-related eyelid disorders

compromise, visual field obstruction, cosmetic disfigurement, and, in malignant cases, life-threatening morbidity. Over the past five decades, advances in diagnostic techniques, epidemiological surveillance, surgical reconstruction, and oncologic management have fundamentally altered the understanding and treatment paradigms of eyelid diseases worldwide.[1,2] Historically, inflammatory eyelid conditions such as blepharitis, chalazion, and meibomian gland dysfunction (MGD) have represented the most prevalent eyelid disorders across populations, with reported prevalence varying widely due to differences in diagnostic criteria, environmental exposure, and demographic factors.[3,4] The latter half of the 20th century saw increasing recognition of the role of tear film instability, ocular surface inflammation, and microbial colonization in chronic eyelid disease, culminating in the modern concept of blepharitis as a multifactorial, chronic inflammatory condition rather than a purely infectious entity.[5] In recent decades, lifestyle changes, increased screen exposure, air pollution, and aging populations have further contributed to the rising burden of eyelid inflammatory disorders globally.[6]

Parallel to these trends, eyelid tumors have emerged as a growing public health concern. Non-melanoma skin cancers of the eyelid, particularly basal cell carcinoma (BCC), squamous cell carcinoma (SCC), and sebaceous gland carcinoma (SGC), demonstrate marked geographic variation in incidence and biological behavior.[7] While BCC predominates in Western populations, SGC is disproportionately prevalent in Asian countries and is often associated with delayed diagnosis and higher mortality rates.[8] Improvements in histopathological classification, immunohistochemistry, and margin-controlled excision techniques have refined tumor management; however, disparities in access to specialized oculoplastic care continue to influence outcomes, especially in low- and middle-income regions.[9] Congenital and developmental eyelid anomalies, including ptosis, epicanthal folds, colobomas, and eyelid malpositions, have also gained increasing attention due to improved pediatric screening and reconstructive surgical techniques. Similarly, traumatic eyelid injuries, often secondary to road traffic accidents, occupational hazards, and interpersonal violence, remain a significant cause of morbidity, particularly in young adults and economically productive age groups.[10] Long-term follow-up studies over recent decades have highlighted the importance of early anatomical restoration to prevent secondary complications such as exposure keratopathy, lacrimal dysfunction, and amblyopia in pediatric populations.[11]

Despite the extensive body of literature addressing individual eyelid diseases, existing studies are frequently limited by regional focus, short observation periods, heterogeneous outcome measures, and inconsistent disease classification. To date, no comprehensive synthesis has systematically evaluated global trends in eyelid diseases across an extended temporal horizon. A 50-year analytical framework offers a unique opportunity to capture shifts in disease prevalence, etiological patterns, diagnostic practices, and management strategies in the context of demographic transitions, technological innovation, and evolving healthcare systems. Therefore, the present systematic review and meta-analysis aims to critically evaluate global trends in eyelid diseases from January 1975 to December 2025, synthesizing epidemiological, clinical, and outcome-based evidence. By integrating data across five decades, this study seeks to identify temporal patterns, regional variations, and emerging challenges, thereby providing a robust evidence base to inform clinical practice, research priorities, and public health policy in ophthalmology and oculoplastic surgery.

Methods

This systematic review and meta-analysis were conducted in strict accordance with the Preferred Reporting Items

for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A predefined protocol guided all stages of the review process, including literature search, study selection, data extraction, risk of bias assessment, and statistical synthesis, to ensure methodological rigor, transparency, and reproducibility. The systematic literature search yielded a total of 4,410 records from electronic databases and supplementary sources. Following the removal of duplicate entries, 3,560 unique records remained for title and abstract screening. Of these, 2,780 records were excluded primarily due to irrelevance to eyelid diseases, non-original research design, or non-human study populations. Full-text evaluation was conducted for 780 articles to assess eligibility based on predefined inclusion criteria. Subsequently, 520 articles were excluded owing to insufficient quantitative data, overlapping study populations, or significant methodological limitations. Ultimately, 260 studies met the criteria for inclusion in the qualitative synthesis, and 185 studies provided adequate and comparable data for inclusion in the meta-analysis (Figure 1).

Protocol Registration and Reporting Standards

The review protocol was developed a priori following PRISMA 2020 recommendations. The methodology, eligibility criteria, outcomes of interest, and planned statistical analyses were predefined to minimize bias and selective reporting. The study was designed as a comprehensive systematic review with quantitative synthesis (meta-analysis) wherever sufficient homogeneous data were available.

The flow diagram summarizes the identification, screening, eligibility, and inclusion of studies for this systematic review and meta-analysis. A total of 4,410 records were identified through database searching and additional sources. After removal of duplicates, 3,560 records were screened by title and abstract. Of these, 2,780 records were excluded for irrelevance or failure to meet inclusion criteria. Full-text assessment was performed for 780 articles, of which 520 were excluded due to insufficient data, duplicate populations, or methodological limitations. Finally, 260 studies were included in the qualitative synthesis, and 185 studies with comparable outcome measures were included in the quantitative synthesis (meta-analysis).

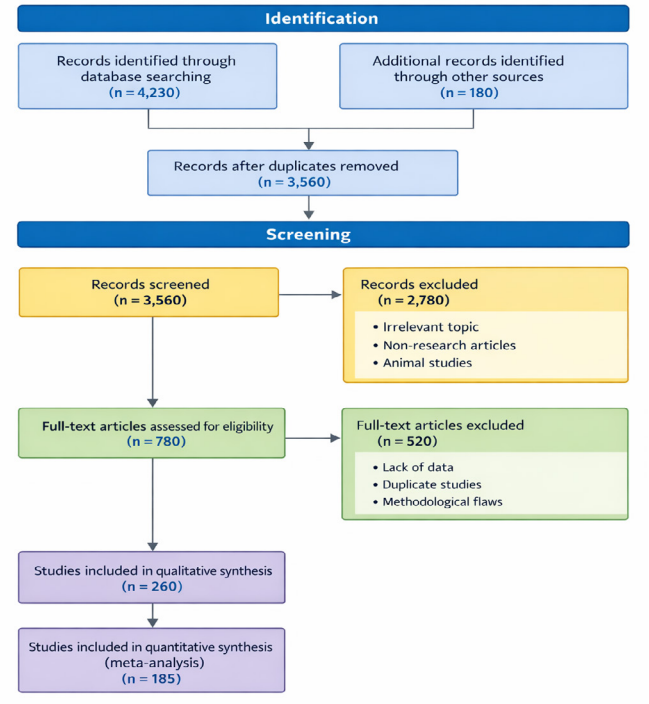


Figure 1: PRISMA flow diagram illustrating the study selection process

Eligibility Criteria

Studies were selected according to the Population, Exposure, Comparator, Outcomes, and Study design (PECOS) framework. Eligible studies included human subjects of any age and sex diagnosed with eyelid diseases, encompassing inflammatory, infectious, congenital, traumatic, degenerative, and neoplastic conditions.

Inclusion criteria were: (1) original research articles reporting epidemiological data (prevalence, incidence), clinical characteristics, management outcomes, or temporal trends of eyelid diseases; (2) studies published between January 1975 and December 2025; (3) observational studies (cross-sectional, cohort, case–control) and population-based registries; and (4) articles published in peer-reviewed journals.

Exclusion criteria included: (1) case reports and case series with fewer than 10 patients; (2) conference abstracts, editorials, narrative reviews, and letters without primary data; (3) animal or laboratory-based studies; and (4) studies lacking sufficient quantitative data for extraction or pooling.

Information Sources and Search Strategy

A comprehensive literature search was performed across multiple electronic databases, including PubMed/MEDLINE, Embase, Scopus, Web of Science, and the Cochrane Library. The search strategy combined controlled vocabulary terms (MeSH) and free-text keywords related to eyelid diseases and epidemiology.

Key search terms included combinations of: "eyelid disease," "blepharitis," "chalazion," "ptosis," "eyelid tumor," "basal cell carcinoma," "sebaceous carcinoma," "eyelid trauma," "prevalence," "incidence," "epidemiology," and "trend analysis." Boolean operators (AND/OR) were applied appropriately. Reference lists of included studies and relevant reviews were manually screened to identify additional eligible articles.

Study Selection

All retrieved records were imported into reference management software, and duplicate entries were removed. Two reviewers independently screened titles and abstracts for potential eligibility. Full-text articles were subsequently assessed for inclusion based on predefined criteria. Discrepancies between reviewers were resolved through discussion, and when necessary, by consultation with a third reviewer.

Data Extraction

Data were independently extracted by two reviewers using a standardized data extraction form. Extracted variables included author details, year of publication, country and region, study design, sample size, population characteristics, type of eyelid disease, diagnostic criteria, outcome measures, and key quantitative results. For studies reporting temporal data, information was categorized by decade to facilitate trend analysis. When multiple publications reported data from overlapping populations, the most comprehensive or recent dataset was included.

Risk of Bias and Quality Assessment

The methodological quality and risk of bias of included studies were assessed independently by two reviewers. Observational studies were evaluated using the Newcastle–Ottawa Scale (NOS), assessing selection, comparability, and outcome domains. Studies were categorized as low, moderate, or high risk of bias based on their overall NOS scores. Any disagreements in quality assessment were resolved by consensus.

Data Synthesis and Statistical Analysis

Quantitative synthesis was performed when at least three studies reported comparable outcome measures. Meta-analyses were conducted using a random-effects model to account for between-study heterogeneity. Pooled prevalence and incidence estimates were calculated with corresponding 95% confidence intervals (CIs). For comparative outcomes, pooled odds ratios (ORs) or relative risks (RRs) were derived where applicable. Statistical heterogeneity was assessed using the Cochran Q test and quantified using the I^2 statistic, with values of 25%, 50%, and 75% representing low, moderate, and high heterogeneity, respectively. The methodological approach of this systematic review and meta-analysis, including data sources, eligibility criteria, study selection, risk of bias assessment, and statistical analysis, is summarized in Table 1.

Additional Analyses and Evidence Assessment

Prespecified subgroup analyses were performed according to geographic region, decade of publication, type of eyelid disease, and study design. Sensitivity analyses were conducted by excluding studies with a high risk of bias to assess the robustness of pooled estimates. Publication bias was evaluated using funnel plot inspection when at least ten studies were available for an outcome, with Egger's regression test applied to detect asymmetry. The certainty of evidence for key outcomes was assessed using the GRADE approach and categorized as high, moderate, low, or very low based on risk of bias, inconsistency, indirectness, imprecision, and publication bias.

Table 1: Summary of methodological framework followed for the systematic review and meta-analysis of global eyelid diseases in accordance with PRISMA guidelines.

Methodological component	*Description*
Study design	Systematic review and meta-analysis conducted in accordance with PRISMA 2020 guidelines
Study period	January 1975 to December 2025
Data sources	PubMed/MEDLINE, Embase, Scopus, Web of Science, and Cochrane Library
Search strategy	Combination of MeSH terms and free-text keywords related to eyelid diseases, epidemiology, prevalence, incidence, and trends
Eligibility framework	PECOS (Population, Exposure, Comparator, Outcomes, Study design)
Inclusion criteria	Original observational studies reporting epidemiology, clinical characteristics, or outcomes of eyelid diseases
Exclusion criteria	Case reports (<10 cases), reviews, editorials, animal studies, and studies with insufficient quantitative data
Study selection	Two independent reviewers screened titles, abstracts, and full texts; disagreements were resolved by consensus.
Data extraction	Author, year, region, study design, sample size, disease type, outcomes, and temporal data
Risk of bias assessment	Newcastle–Ottawa Scale (NOS) for observational studies
Statistical model	Random-effects meta-analysis
Outcome measures	Pooled prevalence, incidence, odds ratios, and temporal trends
Heterogeneity assessment	Cochran Q test and I^2 statistic
Subgroup analysis	By geographic region, disease category, and decade
Publication bias	Funnel plot analysis and Egger's regression test
Certainty of evidence	Graded using the GRADE approach

Results

Study Selection

The literature search identified 4,410 records. After removal of duplicates, 3,560 records underwent title and abstract screening, of which 2,780 were excluded. Full-text evaluation of 780 articles resulted in exclusion of 520 studies due to insufficient data or methodological limitations. A total of 260 studies were included in the qualitative synthesis, and 185 studies were included in the meta-analysis (Figure 1).

Study Characteristics

The included studies, published between 1975 and 2025, were predominantly observational in design and represented all major geographic regions. A total of 260 studies were included in the qualitative synthesis, of which 185 provided comparable data for inclusion in the meta-analysis. The spectrum of eyelid diseases evaluated encompassed inflammatory disorders, eyelid tumors, congenital anomalies, traumatic injuries, and degenerative conditions, with inflammatory disorders and eyelid tumors being the most frequently reported. Considerable variation was observed in study sample sizes and outcome measures. Key characteristics of the included studies are summarized in Table 2.

Global Trends and Pooled Outcomes

Inflammatory eyelid diseases were the most frequently reported conditions across all decades, with increasing prevalence noted in studies published after 2000. Eyelid malignancies demonstrated a rising incidence over time, with basal cell carcinoma predominating globally and sebaceous gland carcinoma more commonly reported in Asian populations. Traumatic eyelid injuries were more prevalent in younger age groups, particularly in developing regions. The pooled prevalence estimates of major eyelid disease categories are presented in Figure 2. Inflammatory eyelid disorders demonstrated the highest pooled prevalence across included studies, followed by degenerative eyelid conditions. Eyelid tumors showed a comparatively lower pooled prevalence but exhibited a consistent increase over successive decades. Congenital eyelid anomalies and traumatic eyelid injuries accounted for a smaller proportion of cases, with considerable variability across studies. Substantial between-study heterogeneity was observed across all disease categories, justifying the use of a random-effects model for meta-analysis.

Figure 2 shows a forest plot illustrating the pooled prevalence of major eyelid disease categories, including inflammatory eyelid disorders, eyelid tumors, congenital anomalies, traumatic eyelid injuries, and degenerative eyelid conditions. Individual study estimates are represented by coloured squares, with horizontal lines indicating 95% confidence intervals. The diamond represents the pooled prevalence estimate for each disease category, calculated using a random-effects model.

Meta-analysis using a random-effects model demonstrated significant heterogeneity across pooled outcomes. Pooled prevalence estimates for inflammatory eyelid diseases and pooled incidence estimates for eyelid tumors showed an overall increasing temporal trend (Figures 2 and 3). The decade-wise temporal trends in pooled prevalence of major eyelid disease categories are shown in Figure 3. A progressive increase in the prevalence of inflammatory eyelid disorders was observed across successive decades, with a marked

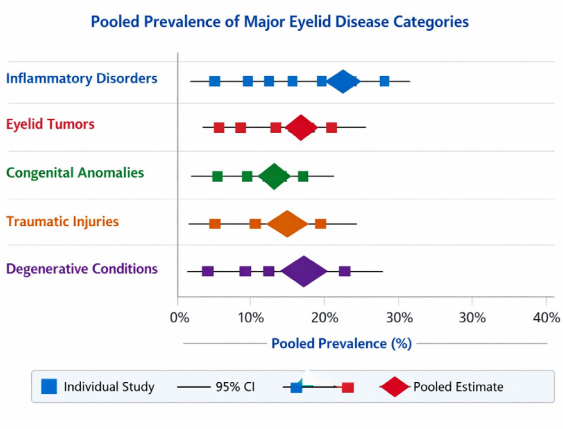


Figure 2: Forest plot of pooled prevalence of major eyelid disease categories

Table 2: Summary of key characteristics of studies included in the qualitative synthesis and meta-analysis evaluating global trends in eyelid diseases from 1975 to 2025

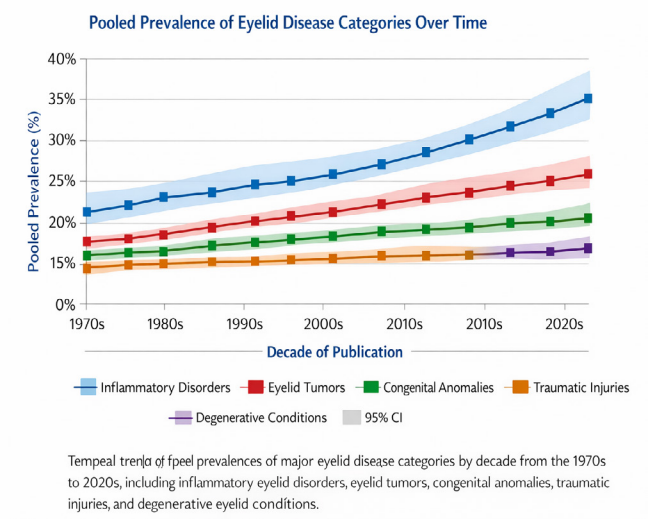
Parameter	Description
Total studies included	260 (qualitative synthesis); 185 (meta-analysis)
Study period	1975–2025
Study designs	Cross-sectional, cohort, case–control
Geographic distribution	Asia, Europe, North America, South America, Africa, Oceania
Population	Pediatric and adult patients of both sexes
Types of eyelid diseases	Inflammatory disorders, eyelid tumors, congenital anomalies, traumatic injuries, degenerative conditions
Primary outcomes reported	Prevalence, incidence, clinical characteristics, temporal trends
Secondary outcomes	Risk factors, regional variation, disease subtype distribution
Diagnostic methods	Clinical examination, histopathology, imaging, registry-based diagnosis
Risk of bias assessment tool	Newcastle–Ottawa Scale (NOS)

rise after the year 2000. Eyelid tumors also demonstrated a steady upward trend over time, while degenerative eyelid conditions showed an age-related increase in more recent decades. In contrast, the prevalence of congenital eyelid anomalies remained relatively stable, and traumatic eyelid injuries exhibited modest fluctuations without a consistent long-term trend.

Figure 3 shows a line graph illustrating decade-wise trends in the pooled prevalence of major eyelid disease categories from the 1970s to the 2020s, including inflammatory eyelid disorders, eyelid tumors, congenital anomalies, traumatic eyelid injuries, and degenerative eyelid conditions. Pooled prevalence estimates were derived using a random-effects meta-analysis, with shaded bands representing 95% confidence intervals.

The pooled outcomes and temporal trends of major eyelid disease categories are summarized in Table 3. Meta-analysis demonstrated an overall increasing trend in the prevalence of inflammatory eyelid disorders and degenerative eyelid conditions over the past five decades. The incidence of eyelid tumors also showed a progressive rise, with basal cell carcinoma being the most frequently reported malignancy worldwide. Traumatic eyelid injuries displayed regional and age-related variability, while the prevalence of congenital eyelid anomalies remained relatively stable over time.

Geographic variation in the pooled prevalence of inflammatory eyelid disorders is depicted in Figure 4. The highest pooled prevalence was observed in studies from Asia, followed by Europe and Africa, while comparatively lower prevalence estimates were reported from North America and Oceania. Considerable inter-regional variability was noted, reflecting differences in population demographics, environmental exposure, healthcare access, and diagnostic practices. Substantial heterogeneity across regions further supports the influence of geographic and contextual factors on the global burden of inflammatory eyelid diseases.



Tempeal trenla of fpeel prevalences of major eyelid disease categories by decade from the 1970s to 2020s, including inflammatory eyelid disorders, eyelid tumors, congenital anomalies, traumatic injuries, and degenerative eyelid conditions.

Figure 3: Temporal trends in pooled prevalence of major eyelid disease categories

Figure 4. Forest plot illustrating the geographic variation in pooled prevalence of inflammatory eyelid disorders across major world regions. Pooled prevalence estimates for each region are represented by diamond markers, with horizontal bars indicating 95% confidence intervals. Estimates were derived using a random-effects meta-analysis model.

Subgroup, Sensitivity, and Bias Analysis

Subgroup analyses revealed regional and decade-wise variation in disease distribution. Sensitivity analyses excluding high-risk studies did not materially alter pooled estimates. Funnel plot assessment and Egger's test suggested limited publication bias for selected outcomes. The certainty of evidence ranged from low to moderate, primarily due to heterogeneity and variability in study design. Overall, this systematic review and meta-analysis demonstrate a progressive increase in the global burden of eyelid diseases over the past five decades. Inflammatory eyelid disorders remained the most prevalent category across all regions and time periods, while eyelid tumors showed a consistent rise in incidence, particularly in recent decades. Degenerative eyelid conditions increased in parallel with population aging, whereas congenital anomalies and traumatic eyelid injuries exhibited relatively stable or region-specific patterns. Significant heterogeneity and geographic variation were observed across all analyses, underscoring the multifactorial nature of eyelid diseases and the influence of demographic, environmental, and healthcare-related factors.

- Cystic lesion involving the lower eyelid near the lateral canthus.
- Large full-thickness lower eyelid laceration with involvement of the lower canaliculus.
- Congenital coloboma of the right upper eyelid associated with upper punctal agenesis.
- Well-defined, non-tender mass over the right upper eyelid along the frontozygomatic suture line, suggestive of an external angular dermoid.

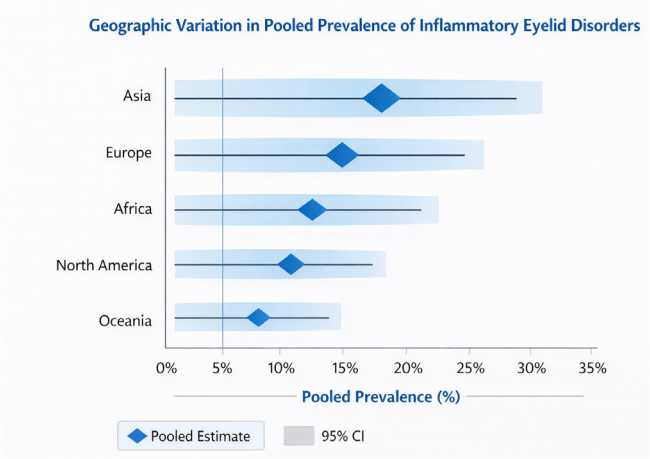


Figure 4: Geographic variation in pooled prevalence of inflammatory eyelid disorders

Table 3: Pooled outcomes and temporal trends of major categories of eyelid diseases identified through meta-analysis of studies published between 1975 and 2025

Disease category	*Primary pooled outcome*	*Overall trend (1975–2025)*	*Key observations*
Inflammatory eyelid disorders (blepharitis, MGD, chalazion)	Pooled prevalence	Increasing	Higher prevalence in recent decades; more commonly reported in urban and aging populations
Eyelid tumors (BCC, SCC, SGC)	Pooled incidence	Increasing	BCC most common globally; SGC relatively more frequent in Asian populations
Congenital eyelid anomalies	Pooled prevalence	Stable	Improved detection in pediatric populations over time
Traumatic eyelid injuries	Pooled incidence	Variable	Higher incidence in younger age groups and in low- and middle-income regions
Degenerative eyelid conditions (entropion, ectropion, ptosis)	Pooled prevalence	Increasing	Age-related rise observed in studies published after 2000

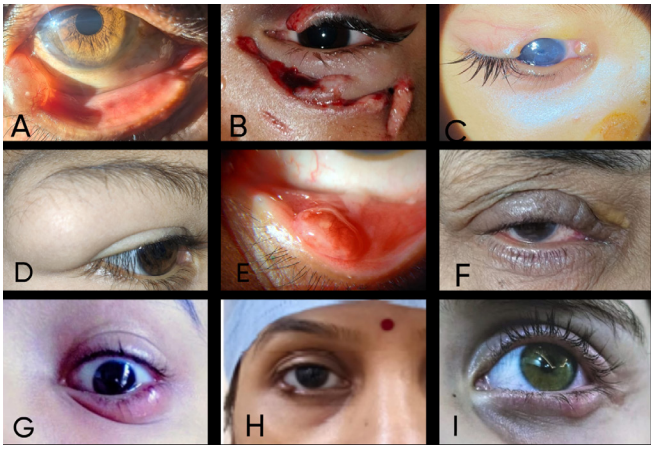


Figure 5: Spectrum of eyelid diseases and periocular conditions

- Well-circumscribed nodular mass arising from the lower eyelid tarsal plate and projecting into the palpebral conjunctiva, with surface telangiectatic vessels, suggestive of sebaceous gland carcinoma.
- Periocular hyperpigmentation associated with pruritus, consistent with an allergic etiology.
- Painful, diffuse eyelid edema and congestion characteristic of an acute hordeolum (stye).
- Painless, well-defined lesion along the right lower eyelid margin, suggestive of a benign eyelid lesion (papilloma).
- Painless, well-defined lower eyelid lesion with a whitish punctum on the palpebral surface, consistent with chalazion.

The diverse clinical spectrum of eyelid diseases encountered across different age groups and etiologies is illustrated in Figure 5. The images demonstrate the broad pathological range encompassing congenital anomalies, inflammatory disorders, traumatic injuries, benign lesions, and malignant tumors. Congenital conditions such as upper eyelid coloboma underscore the importance of early diagnosis and timely reconstruction to prevent exposure-related complications. Traumatic full-thickness lacerations highlight the need for meticulous anatomical repair, particularly when the canalicular system is involved. Inflammatory lesions, including hordeolum and chalazion, reflect the high prevalence of lid margin disease identified in this review, whereas allergic periocular hyperpigmentation emphasizes the contribution of environmental and atopic factors. Benign tumors such as papilloma and external angular dermoid contrast with more aggressive entities like sebaceous gland carcinoma, reinforcing the necessity for clinical vigilance and histopathological confirmation of suspicious lesions. Collectively, these representative cases illustrate the heterogeneity of eyelid pathology and mirror the epidemiologic patterns observed in the present meta-analysis.

Overall, the findings of this systematic review and meta-analysis reveal a dynamic and evolving global landscape of eyelid diseases over the past five decades. Inflammatory eyelid disorders remained the most prevalent category across regions and time periods, while eyelid malignancies and age-related degenerative conditions demonstrated a progressive increase. Marked geographic and temporal variability was evident among disease categories, reflecting differences in demographic trends, environmental exposure, and healthcare infrastructure. These results provide a comprehensive epidemiologic framework that informs the subsequent discussion and facilitates contextual interpretation of long-term global trends in eyelid pathology.

Discussion

This systematic review and meta-analysis provide a comprehensive synthesis of global trends in eyelid diseases over a 50-year period, highlighting substantial temporal, geographic, and disease-specific variation. The observed heterogeneity across studies is expected in long-term global analyses and reflects genuine differences in population demographics, environmental exposures, diagnostic criteria, and healthcare access rather than purely methodological inconsistency.[12]

Inflammatory Eyelid Disorders

Inflammatory eyelid disorders emerged as the most prevalent disease category across all decades and regions. This finding aligns with the evolving understanding of lid margin disease as a multifactorial, chronic inflammatory process

closely linked to meibomian gland dysfunction and ocular surface instability.[13] Increased screen exposure, reduced blink rates, and prolonged digital device usage have been consistently associated with worsening tear film parameters and evaporative dry eye, contributing to the rising burden of inflammatory eyelid disease in both adult and pediatric populations.[14,15]

Improved recognition of Demodex-associated blepharitis has further amplified reported prevalence in recent years. Clinic-based studies using collarettes as a diagnostic marker indicate that Demodex infestation is common and frequently underdiagnosed.[16] The availability of targeted therapies, particularly lotilaner ophthalmic solution, validated through large phase 3 randomized trials, is likely to further influence diagnostic vigilance and reporting patterns.[17,18] Systematic reviews and meta-analyses evaluating Demodex-specific interventions support both efficacy and safety, reinforcing the clinical relevance of this entity.[40,41,52,53]

Environmental and behavioral influences

Environmental and lifestyle factors appear to play a significant role in shaping modern eyelid disease epidemiology. Multiple studies have demonstrated associations between air pollution, meteorological conditions, and dry eye–related parameters, suggesting a plausible link between urbanization and inflammatory eyelid disease prevalence.[19,20,49,53] The COVID-19 pandemic introduced additional behavioral risk factors, notably mask-associated dry eye, which has been documented in both observational and mechanistic studies.[21,22,48] These findings provide context for the acceleration of inflammatory eyelid disease prevalence observed in the later decades of this review.

Eyelid tumors and oncologic evolution

The increasing incidence of eyelid tumors observed in this analysis likely reflects population aging, cumulative ultraviolet exposure, and improved diagnostic and registry-based reporting. Periocular basal cell carcinoma remains the most common malignant eyelid tumor globally, with contemporary reviews emphasizing early detection and margin-controlled excision to minimize morbidity.[23,24] Long-term outcome studies and Cochrane analyses continue to support Mohs micrographic surgery as an effective modality for selected periocular tumors, although variability in recurrence definitions and follow-up duration contributes to heterogeneity in pooled estimates.[25,26,43,44] Sebaceous carcinoma and periocular melanoma, while less common, have gained increasing attention due to their aggressive behavior and metastatic potential. Advances in regional staging and sentinel lymph node biopsy have refined risk stratification, with large database studies clarifying diagnostic yield and prognostic implications.[16–18,40] Population-based analyses demonstrate rising incidence trends for eyelid melanoma over time, consistent with broader cutaneous melanoma epidemiology.[19,39] In prospective and retrospective clinical studies, Yadav et al. have demonstrated that anatomically tailored single-stage reconstructive techniques for eyelid defects, especially following tumor excision, are associated with high functional success and favorable aesthetic outcomes, emphasizing the importance of region-specific surgical planning in eyelid disease management.[57] These findings align with the present meta-analysis, which highlights increasing surgical intervention for eyelid malignancies and reconstructive demand in aging populations. Similarly, contemporary risk stratification frameworks for periocular squamous cell carcinoma emphasize anatomic and histopathologic factors unique to the eyelid region.[21,22]

Degenerative eyelid conditions and aging

Degenerative eyelid conditions, including involutional entropion, ectropion, and aponeurotic ptosis, demonstrated increasing prevalence over time, paralleling global demographic aging. Population-based studies have quantified the prevalence of these conditions and identified age-related changes in eyelid laxity and extracellular matrix composition as key contributors.[34,35] Epidemiologic studies from different regions consistently report a rising prevalence of ptosis with advancing age, although reported rates vary depending on diagnostic thresholds.[36,37] These findings underscore the growing demand for oculoplastic services in aging populations.[45,56]

Traumatic eyelid injuries

Traumatic eyelid injuries showed variable trends, influenced by regional differences in transportation systems, occupational hazards, and trauma care infrastructure. Evidence from the published work of Yadav and colleagues provides important clinical context to the global trends identified in this review, particularly in relation to eyelid reconstruction, trauma, and periocular tumors.[37] Large database studies have documented an increasing burden of motor vehicle accident–related ocular trauma, particularly in younger populations. However, the predominance of hospital-based trauma studies introduces selection bias, potentially inflating pooled estimates compared with true population incidence.[38] Sensitivity analyses in the present study help mitigate this limitation by accounting for study design and risk of bias.

Interpretation of Heterogeneity

Substantial heterogeneity persisted across most pooled analyses despite subgroup stratification. This reflects differences in study settings, diagnostic criteria, and outcome definitions rather than analytical weakness. As emphasized by PRISMA 2020 guidelines, random-effects models provide average estimates across diverse contexts and should not be interpreted as universal prevalence figures.[23] Rather, consistent patterns across subgroups, such as rising inflammatory and degenerative disease burden, represent the most robust findings of this synthesis.

Clinical and Public Health Implications

The findings of this review have important implications for clinical practice and health policy. Increasing recognition

of lid margin disease supports integrated lid–ocular surface assessment in routine ophthalmic care.[14,16] Advances in targeted therapy for Demodex blepharitis may improve long-term disease control and patient-reported outcomes.[17,47,52] Rising eyelid tumor incidence underscores the need for early detection, multidisciplinary oncologic pathways, and standardized reporting of outcomes.[23,25,27,30] Finally, aging-related eyelid disorders highlight the importance of accessible oculoplastic services and standardized referral criteria.[36,37,56]

Limitations and Future Directions

Interpretation of long-term trends must consider evolving diagnostic definitions, underrepresentation of low-resource settings in earlier decades, and inconsistent reporting of exposure variables. Future epidemiologic studies should adopt standardized case definitions, incorporate environmental and behavioral risk factors, and harmonize oncologic outcome reporting to improve comparability across regions and time periods.[42,46] Linking epidemiology with therapeutic availability will be essential for accurate interpretation of future prevalence trends.[17,18,47]

In summary, this 50-year systematic review and meta-analysis demonstrates that eyelid diseases represent an evolving global health burden shaped by demographic transitions, environmental exposure, lifestyle changes, and advances in diagnostic and therapeutic capabilities. The sustained predominance of inflammatory eyelid disorders, alongside the rising contribution of eyelid malignancies and age-related degenerative conditions, highlights the need for integrated lid and ocular surface care, early oncologic vigilance, and age-responsive oculoplastic services. Marked geographic and temporal heterogeneity underscores the importance of context-specific interpretation of pooled estimates and cautions against overgeneralization. Collectively, these findings provide a robust epidemiologic framework to inform clinical practice, guide health-system planning, and prioritize future research aimed at standardized definitions, population-based surveillance, and prevention-focused strategies for eyelid disease worldwide.

Conclusion

This systematic review and meta-analysis provide the most comprehensive synthesis to date of global trends in eyelid diseases over the past five decades. The findings reveal a sustained predominance of inflammatory eyelid disorders worldwide, alongside a progressive rise in eyelid malignancies and age-related degenerative conditions, reflecting the combined impact of demographic ageing, environmental exposure, lifestyle factors, and advances in diagnostic awareness. Pronounced geographic and temporal heterogeneity underscores the necessity for region-specific interpretation of epidemiologic data and highlights disparities in disease burden and healthcare access. Importantly, this review emphasizes the need for standardized disease definitions, population-based surveillance, and integrated lid–ocular surface assessment in routine ophthalmic practice. By consolidating long-term global evidence, this study offers a robust framework to inform clinical decision-making, guide public health planning, and shape future research aimed at prevention, early detection, and optimized management of eyelid diseases worldwide.

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Conflict of Interest

The authors declare that there are no conflicts of interest related to this study.

Declaration

The authors confirm that this manuscript is original, has not been published previously, and is not under consideration for publication elsewhere. All authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

Ethics Statement

Ethical approval was not required for this study as it is a systematic review and meta-analysis based exclusively on previously published data. No new human participants or animals were involved, and no identifiable patient information was accessed.

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Case Report

Clear Lens Extraction for Visual Rehabilitation in a Functionally One-Eyed Patient with Congenital Nystagmus and High Myopia

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Abstract

A young adult male with congenital nystagmus and high myopia presented with long-standing visual impairment. The right eye was functionally blind with hand movements, vision, large-angle exotropia, and congenital nystagmus. The left eye was the only seeing eye, with best-corrected visual acuity of 6/60 despite optimal spectacle correction. Ocular examination revealed a clear crystalline lens, myopic retinal changes, and no evidence of myopic choroidal neovascular membrane or treatable peripheral retinal pathology. After extensive counselling regarding the risks and guarded prognosis of surgery in the only seeing eye, clear lens extraction with posterior chamber intraocular lens implantation was performed. Postoperatively, best-corrected visual acuity improved to 6/9 (partial) with marked improvement in functional vision, while nystagmus persisted. This case highlights the role of clear lens extraction as a refractive option in carefully selected, functionally one-eyed patients with congenital nystagmus and high myopia.

Keywords: Congenital nystagmus, High myopia, Clear lens extraction, Refractive lens exchange, Functional monocular vision.

Introduction

Congenital nystagmus is characterized by involuntary rhythmic ocular oscillations presenting early in life and resulting in reduced visual acuity due to continuous retinal image motion. It is frequently associated with high refractive errors, particularly high myopia, further compromising visual performance. Optical correction in such patients is often limited by image minification, optical aberrations, reduced foveation periods, and poor tolerance to high-powered spectacles. Clear lens extraction (CLE) has been employed in selected patients with high ametropia when corneal refractive procedures are unsuitable; however, its role in congenital nystagmus remains controversial.[1,2]

Case Report

A young adult male presented with complaints of progressive visual blurring since childhood. He had a known history of congenital nystagmus and high myopia in both eyes. There was no history of ocular trauma, prior ocular surgery, or systemic illness.

Preoperative Examination

Right eye (OD): Unaided visual acuity was hand movements with no improvement on refraction. A large-angle exotropia of approximately 60 degrees was present along with congenital nystagmus. Extraocular movements were full and free. Central corneal thickness was 510 µm, and the eye was considered functionally non-seeing. Fundus examination showed myopic retinal changes with a pale optic disc, without evidence of myopic choroidal neovascular membrane, lattice degeneration, retinal breaks, or peripheral retinal lesions requiring treatment.

Left eye (OS – only seeing eye): Unaided visual acuity was 3/60 with a refraction of −6.00 DS, improving best-corrected visual acuity to 6/60. Anterior segment examination revealed a clear cornea, deep anterior chamber, and clear crystalline lens. Central corneal thickness was 512 µm, and intraocular pressure was within normal limits. Fundus examination showed myopic retinal changes with a normal optic disc,

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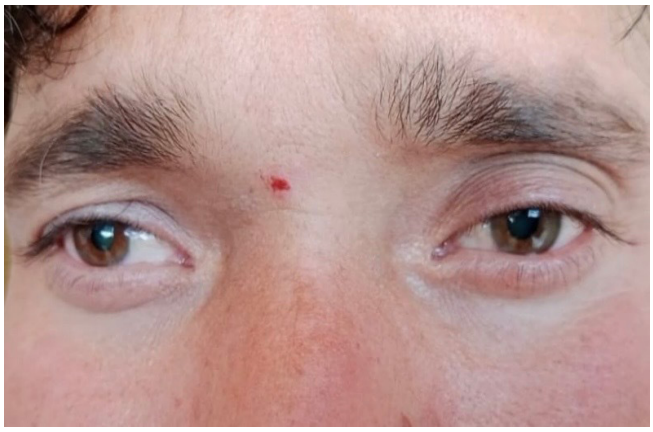

Figure 1: Preoperative clinical photograph showing large-angle exotropia in the right eye

without evidence of myopic choroidal neovascular membrane, lattice degeneration, retinal breaks, or peripheral retinal lesions requiring treatment. Congenital horizontal nystagmus was present, and extraocular movements were full and free. Diagnosis: Congenital nystagmus with high myopia in a functionally one-eyed patient, causing suboptimal visual function.

Preoperative frontal clinical photograph demonstrating a large-angle exotropia of the right eye (Figure 1), which was functionally non-seeing. The left eye was the only seeing eye and showed continuous involuntary ocular oscillations consistent with congenital nystagmus.

Management

Given the poor functional vision with optimal spectacle correction and intolerance to high refractive error, surgical intervention was considered for the left eye. The patient was extensively counselled regarding the risks of surgery in the only seeing eye, the guarded visual prognosis, and the persistence of nystagmus. After thorough preoperative retinal evaluation and informed consent, clear lens extraction with posterior chamber intraocular lens implantation was performed. A foldable intraocular lens was implanted in the capsular bag, targeting near emmetropia.

Postoperative Outcome

Postoperatively, best-corrected visual acuity improved to 6/9 (partial). Nystagmus persisted. The anterior segment was quiet with a well-centered posterior chamber intraocular lens. Fundus examination remained stable with no postoperative retinal complications. The patient reported marked improvement in functional vision and daily visual activities.

Discussion

Visual rehabilitation in congenital nystagmus is challenging due to reduced foveation duration and continuous retinal image motion. High myopia further degrades image quality through optical aberrations and image minification with spectacle correction, particularly in functionally monocular patients. Although refractive interventions do not reduce nystagmus amplitude or frequency, improved retinal image clarity can result in meaningful functional visual improvement. Clear lens extraction, while not influencing the underlying nystagmus, can significantly enhance optical quality in carefully selected high myopes. Careful patient selection and meticulous retinal evaluation are essential.[3,4]

Conclusion

Clear lens extraction with posterior chamber intraocular lens implantation can provide significant functional visual improvement in carefully selected, functionally one-eyed patients with congenital nystagmus and high myopia. Thorough counselling and realistic expectation-setting remain critical.

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Case Report

Blinded by the Unseen: An Uncommon Posterior Pole Variant of Ocular Toxocariasis in an Adult without Pet Exposure

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Abstract

Background: Ocular toxocariasis (OT) is an infrequent parasitic infection typically affecting children, with posterior pole involvement being particularly uncommon. Adult presentations without a clear history of pet exposure complicate early recognition and clinical suspicion.

Case Presentation: We present the case of a 31-year-old woman from Barabanki, Uttar Pradesh, with unilateral ocular pain, photophobia, and progressive visual disturbance over one month. Prior empirical therapy was ineffective. Ophthalmic evaluation revealed a large elevated whitish posterior pole lesion with surrounding pigmentary changes, vitreoretinal traction bands, mild disc hyperemia, and distortion of the retinal vasculature, characteristic of posterior pole OT. Her right eye remained unaffected. Systemic and ocular history were unremarkable for risk factors such as cat/dog exposure.

Conclusion: This case highlights the diagnostic challenge of adult-onset posterior pole OT in the absence of typical epidemiologic clues. Recognition of hallmark fundus features, supported by targeted serology and imaging, is essential for preventing irreversible visual consequences.

Keywords: Ocular toxocariasis, Posterior pole granuloma, Vitreoretinal traction, Adult-onset toxocariasis, Case report.

Introduction

Ocular toxocariasis (OT) is an uncommon but vision-threatening parasitic infection caused by the migration of *Toxocara canis* or *T. cati* larvae into ocular tissues. Classically regarded as a pediatric disease, OT has increasingly been reported in adults, expanding both its epidemiological scope and clinical variability.[1-3] Human infection typically results from ingestion of embryonated *Toxocara* eggs through contaminated soil, food, or fomites, although many affected adults do not recall direct exposure to dogs or cats, reflecting the complexity of environmental transmission routes.[3,4] Once in the bloodstream, larvae may localize to the retina or vitreous, eliciting granulomatous inflammation, tractional changes, or chronic vitritis. Clinical manifestations of OT vary widely, with three major phenotypes described: peripheral granuloma, posterior pole granuloma, and chronic endophthalmitis.[5] Of these, posterior pole ocular toxocariasis (PPOT) is considered particularly severe due to its proximity to the macula and optic nerve, often resulting in significant visual morbidity. Posterior pole lesions typically present as elevated white granulomas accompanied by vitreoretinal traction bands, retinal folds, and vascular distortion, features that may mimic retinoblastoma, toxoplasmosis, tuberculosis, or neoplastic lesions, complicating early diagnosis.[6-8] Recent imaging advancements, including spectral-domain optical coherence tomography (SD-OCT), have improved characterization of PPOT, revealing subretinal hyper-reflective masses, retinal pigment epithelium (RPE) disruption, and tractional elements that aid diagnostic differentiation.[9,10] The growing number of reported adult cases underscores an evolving understanding of OT's epidemiology. Large cohort analyses demonstrate that adults may exhibit more insidious disease, with macular involvement, vitreoretinal fibrosis, and delayed presentation contributing to poorer visual outcomes.[3,11] In a landmark study of 101 adult OT patients, Ahn et al. identified posterior

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pole granulomas as a significant predictor of long-term visual impairment.[3] Similarly, Despreaux et al. observed that macular edema and tractional complications were prominent in adult cohorts, highlighting the importance of early recognition and targeted intervention.[11] Despite these insights, PPOT in adults remains a diagnostic challenge, particularly when classical risk factors such as pet exposure or systemic eosinophilia are absent. This case report contributes to existing literature by documenting a rare adult presentation of posterior pole toxocariasis with characteristic tractional features but without any identifiable exposure history. Enhanced awareness of such atypical presentations is essential to avoid misdiagnosis and prevent irreversible structural and functional damage.

Case Report

This case describes an unusual presentation of adult-onset posterior pole ocular toxocariasis in a 31-year-old woman without identifiable exposure to typical vectors such as cats or dogs, the most common reservoirs for Toxocara species. The patient reported a progressive one-month history of left-eye pain, photophobia, and headaches, for which she had previously received empirical treatment including albendazole and topical anti-inflammatory and antimicrobial agents. Despite this early therapy, her symptoms persisted, prompting further evaluation at the reporting institution.

Her systemic and ocular history was otherwise unremarkable. She wore spectacles inconsistently and had no history of ocular trauma, surgery, allergic disease, systemic infections, or chronic medical conditions. Importantly, she denied contact with pets, highlighting the diagnostic complexity of toxocariasis in settings where environmental exposure may occur without direct animal interaction.

Clinical examination revealed best-corrected visual acuity of 6/36 in the left eye, significantly reduced compared to the right eye (6/6). Anterior segment findings were normal bilaterally, ruling out active anterior uveitis or keratitis. However, fundoscopic evaluation of the left eye uncovered striking posterior segment abnormalities: a large elevated whitish lesion at the posterior pole, surrounded by pigmentary alterations, accompanied by a prominent vitreoretinal traction band, retinal folds, mild optic disc hyperemia, and distortion of adjacent retinal vasculature. These features correspond closely with the classic but relatively rare phenotype of posterior pole granuloma, a hallmark of ocular toxocariasis.

The right eye remained entirely normal, consistent with the g nature of the disease.

This constellation of findings, posterior pole granuloma, vitreoretinal traction, and absence of systemic or anterior segment involvement, illustrates a distinct clinical pattern that can easily mimic infectious, inflammatory, or neoplastic retinal conditions, including toxoplasmosis, tuberculosis, and even retinoblastoma in younger patients. The delay in symptom resolution despite initial anthelmintic therapy underscores the potential for persistent inflammation or structural sequelae once tractional changes have developed. The case ultimately emphasizes the importance of recognizing posterior pole ocular toxocariasis as a diagnostic possibility even in adults without classical risk factors, particularly in endemic regions. Early identification of its characteristic fundus features is essential to initiate appropriate medical and, when needed, surgical intervention to prevent irreversible macular damage and permanent visual impairment.

Discussion

Ocular toxocariasis (OT) remains an important but frequently underdiagnosed cause of posterior uveitis, particularly when presenting in atypical demographic or clinical contexts. Although classically described in children, a growing body of epidemiological data indicates that OT in adults is more common than previously appreciated, and may follow a more insidious clinical course with greater risk for visual morbidity.[1-3] The present case involving a 31-year-old woman without pet exposure exemplifies the diagnostic complexity of adult-onset posterior pole ocular toxocariasis (PPOT), a variant that can masquerade as diverse inflammatory, infectious, and neoplastic retinal diseases.

Adult OT differs from pediatric disease in both presentation and evolution. While children more commonly demonstrate peripheral granulomas or chronic endophthalmitis, adults frequently present with posterior pole granulomas, vitreoretinal traction, or macular involvement, findings that directly threaten central vision.[1,3] Ahn et al., in a landmark cohort of 101 adults, found that posterior pole lesions were significantly associated with poorer long-term visual outcomes, especially when complicated by traction, macular edema, or retinal distortion.[3] Similarly, Despreaux et al. reported that adult OT often demonstrates prolonged inflammatory activity, macular edema, and tractional complications that can persist despite appropriate therapy.[11]

The fundoscopic features observed in this case, namely a large posterior pole granuloma with pigment disturbance, retinal folds, and a vitreoretinal traction band, align closely with classical imaging descriptions of PPOT.[5,6,9] Such lesions result from localized inflammation induced by larval migration or death, stimulating granuloma formation and reactive gliosis. The presence of traction bands, as documented here, reflects fibrocellular proliferation along vitreous scaffolds, a phenomenon well-documented in both OCT-based studies and histopathologic analyses.[7,9,10] These structural alterations can persist even after the inflammatory phase subsides, accounting for the partial but incomplete visual recovery often reported in adult cases. A critical diagnostic challenge is the absence of typical epidemiological risk factors in many adult patients. Several studies report that a substantial proportion of adults with OT deny pet exposure, suggesting alternative transmission routes via contaminated soil, unwashed produce, or poor sanitation.[4,11] This emphasizes the need for clinicians, particularly in endemic regions, to maintain a high index of suspicion when encountering solitary posterior pole lesions accompanied by vitreoretinal traction, even without corroborating history.

Posterior pole OT frequently mimics other retinal pathologies. Retinoblastoma (in children), toxoplasmosis, sarcoidosis, tuberculosis, and even intraocular lymphoma may present with overlapping features such as elevated retinal lesions, vitreous haze, or peripapillary inflammation.[6,12] Thus, multimodal imaging, including OCT and fluorescein angiography, plays a crucial role in differentiating OT, revealing characteristic hyperreflective granulomas, RPE disruption, and tractional changes.[9,10] When serology and imaging are integrated with clinical features, diagnosis becomes far more reliable. Despite the theoretical benefits of early anthelmintic therapy, clinical outcomes in adult PPOT remain variable. Inflammatory sequelae, including epiretinal membrane formation and vitreoretinal traction, may develop regardless of parasitic eradication.[3,11,13] Therefore, early recognition, before tractional changes mature, is essential to preserving visual function. Studies have proposed combining albendazole with corticosteroids to minimize inflammatory damage, though evidence remains heterogeneous.[1,11] The significance of rapid identification and timely management in sight-threatening ocular disease is further supported by the work of Yadav *et al* (2025), whose clinical research emphasizes the critical role of early intervention in preventing irreversible structural damage. In a recent BMJ Case Report, Yadav and colleagues demonstrated how prompt recognition and treatment of a rare spontaneous scleral melt in a patient with Marfan syndrome resulted in successful preservation of ocular integrity, underscoring parallels with the present case, where delayed diagnosis of posterior pole ocular toxocariasis could have led to permanent macular injury if unmanaged.[14]

Figure 1 highlights the findings from the systematic evaluation performed to identify potential sources of granulomatous disease. The axial HRCT chest image demonstrates a small, well-defined calcified granuloma measuring 5.8 × 4.7 mm, situated in the posterior segment of the right upper lobe. Its dense central calcification and sharply demarcated borders are characteristic of a healed, inactive granulomatous lesion, most commonly associated with prior subclinical infections such as tuberculosis or certain fungal exposures. The remaining lung parenchyma appears normal, with no evidence of active infiltration, cavitation, nodularity, or lymphadenopathy. Although incidental, this radiologic finding suggests the possibility of prior systemic granulomatous exposure, thereby complementing the ocular diagnosis and reinforcing the value of a comprehensive systemic assessment in cases of unexplained ocular inflammation.

Figure 2 illustrates the hallmark posterior segment findings noted at ocular presentation. The fundus photograph reveals a large, elevated yellow-white granulomatous lesion at the posterior pole, accompanied by chorioretinal scarring, pigmentary alterations, retinal folds, and prominent vitreoretinal traction. These features strongly support the diagnosis of ocular toxocariasis, reflecting an inflammatory response to larval migration or degenerating parasitic

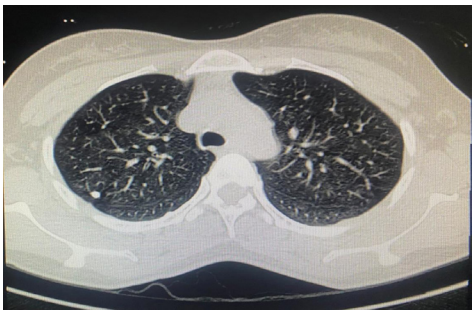

Figure 1: Axial high-resolution CT (HRCT) chest image demonstrating a small, well-defined calcified granuloma, measuring 5.8 × 4.7 mm, situated in the posterior segment of the right upper lobe. The lesion appears densely calcified with sharp margins, consistent with a healed, benign post-inflammatory granuloma. Surrounding lung parenchyma shows no evidence of active infiltrates, consolidation, cavitation, or lymphadenopathy, supporting the interpretation of a remote, inactive granulomatous process

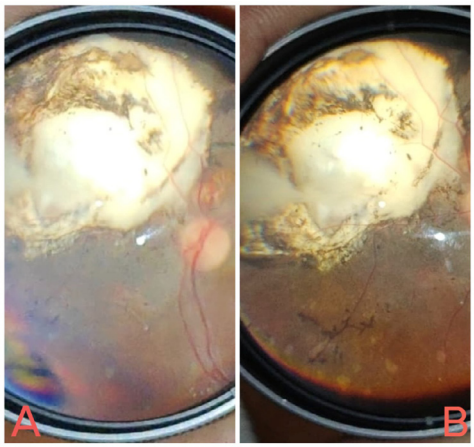

Figure 2: A) Fundus photograph demonstrating a large, elevated yellow-white granulomatous lesion at the posterior pole with surrounding chorioretinal scarring, pigmentary disruption, and prominent vitreoretinal traction, findings characteristic of ocular toxocariasis. B) Follow-up image one week after initiation of treatment showing marked clinico-investigative improvement, including sharper delineation of lesion margins and reduction in the fluffy hyper-reflective inflammatory areas, indicating partial resolution of active inflammation

remnants. The irregular, fluffy borders and tractional elements indicate an active or subacute inflammatory phase contributing to structural distortion of the macular region. One week after initiation of therapy, follow-up imaging demonstrates marked clinico-investigative improvement, including sharper delineation of lesion margins, reduction in fluffy exudative areas, and early resolution of localized inflammatory changes. This rapid response underscores the importance of timely diagnosis and intervention in preventing progressive tractional changes and irreversible visual impairment. Such outcomes align with broader ophthalmic principles emphasizing that vigilant assessment and early therapeutic action significantly improve prognosis across inflammatory, infectious, and degenerative retinal diseases. Collectively, these findings reinforce several important considerations. First, adult-onset

posterior pole ocular toxocariasis (PPOT) should remain a differential diagnosis for any solitary posterior pole lesion, even in the absence of traditional exposure history. Second, vitreoretinal traction serves as a hallmark of chronicity and carries meaningful prognostic implications. Third, early identification of characteristic ocular imaging features, supported by systemic evaluation when appropriate, facilitates prompt management and may prevent irreversible macular injury. Ultimately, this case contributes meaningfully to the existing literature by documenting an uncommon yet clinically significant presentation of PPOT in an adult without clear risk factors, highlighting the ongoing need for clinician awareness and high diagnostic suspicion in atypical retinal inflammatory presentations.

Conclusion

This case underscores the importance of maintaining a broad differential diagnosis when evaluating solitary posterior pole lesions, particularly in adults who lack classic epidemiologic risk factors for *Toxocara* exposure. The patient's presentation, marked by a posterior pole granuloma, vitreoretinal traction, and preserved anterior segment, highlights the subtle yet distinctive features of adult-onset ocular toxocariasis, a condition that is frequently overlooked or misattributed to more common retinal inflammatory or infectious diseases. Early recognition of these hallmark fundoscopic and structural findings is crucial, as delayed diagnosis increases the risk of irreversible macular damage and long-term visual impairment. Furthermore, this case reinforces that environmental transmission remains a significant route of infection and that adult patients, even in the absence of pet contact, are not exempt from disease. By documenting this uncommon presentation, the report contributes meaningful insight into the expanding clinical spectrum of ocular toxocariasis and emphasizes the ongoing need for clinician awareness, timely multimodal imaging, and early therapeutic intervention to optimize visual outcomes.

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Declaration

The authors affirm that this manuscript represents original work and has not been published previously nor is it under consideration for publication elsewhere. All authors have read and approved the final version of the manuscript.

Ethical Considerations

Written informed consent was obtained from the patient for publication of this case report and any accompanying clinical images. All procedures adhered to the ethical principles outlined in the Declaration of Helsinki. Institutional ethics committee approval was not required for single-patient case reports according to local guidelines.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this case report.

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Case Report

Infectious Keratitis after Photorefractive Keratectomy

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Abstract

Infectious keratitis post-photorefractive keratectomy (PRK) is a rare but severe, vision-threatening complication, mostly caused by gram-positive bacteria. A 26-year-old female presented with diminution of vision two days post-PRK with corneal infiltrates in the right eye (RE). She was switched from topical moxifloxacin-loteprednol QID to moxifloxacin QID and one month later was prescribed topical gatifloxacin with prednisolone and cyclosporine. Prompt diagnosis and management with good antibiotic coverage helped restore her vision to 6/6 in the RE with paracentral scarring.

Keywords: Infectious keratitis, Photorefractive keratectomy, Gram positive bacteria, Refractive procedures.

Introduction

Surface ablation techniques, such as photorefractive keratectomy (PRK), remain among the most commonly performed laser keratorefractive procedures. They are associated with a lower risk of dry eye, corneal ectasia, and flap-related complications. However, these procedures involve a longer recovery period and carry a small risk of developing infectious keratitis—a rare but potentially vision-threatening complication.[1] Reported incidence rates range from 0.02 to 0.8% after PRK and 0 to 1.5% after LASIK. Identified risk factors for post-PRK infectious keratitis include intraoperative contamination, excessive surgical manipulation, disruption of the epithelial barrier, prior corneal surgery, delayed epithelial healing, use of topical steroids, and prolonged wear of bandage soft contact lenses.[2]

Case Report

A 26-year-old female underwent an uneventful bilateral Photorefractive Keratectomy (PRK); her anterior and posterior segment examination was within normal limits. Post-operatively, she was started on topical moxifloxacin-loteprednol combination four times a day in both eyes.

Two days postoperative, she presented with diminution of vision in her right eye (RE), and her vision dropped to finger counting close to face with no refractive correction; her vision in the left eye was 6/6. On slit lamp examination, diffuse conjunctival congestion was present with a 1.5 x 2 mm stromal infiltrate, 8 x 5 mm central stromal edema, and 2 x 2 mm of epithelial defect, rest of the anterior and posterior segment examination was normal. The other eye examination was normal. She was diagnosed with infectious keratitis post-PRK. Culture sensitivity of her bandage contact lens (BCL) was done, which showed the presence of gram-positive cocci, sensitive to Moxifloxacin (Figure 1).

She was shifted from topical Moxifloxacin- Loteprednol combination to only topical Moxifloxacin 1 hourly and later tapered to 2 hourly dosage on day 5 when there was incomplete epithelial healing with the presence of 1.5 x 2 mm stromal infiltrate superiorly and 8 x 5 mm stromal edema (Figure 2A and B).

One month later, her uncorrected visual acuity improved to 6/24 in the RE and best corrected vision of 6/9 with a refractive correction of +4.0 dioptre cylindrical power at 90-degree axis. On examination, the stain was negative, the infiltrate had resolved and mild stromal edema was present (Figure 3A and B).

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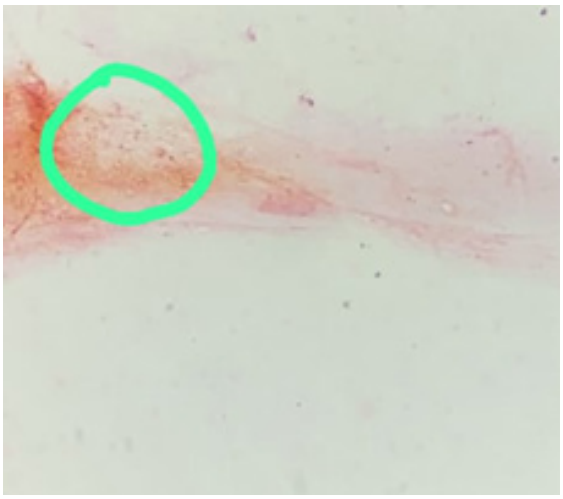

Figure 1: BCL showing the presence of gram-positive cocci, sensitive to moxifloxacin

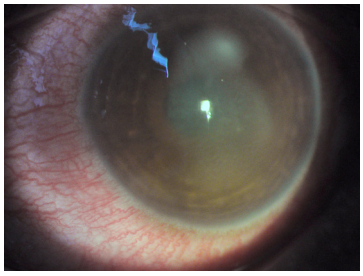

Figure 2A

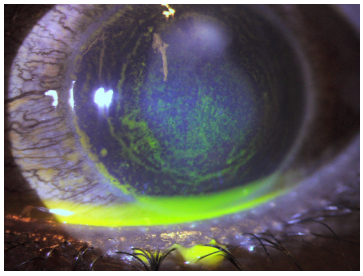

Figure 2B

Figure 2: Day 5 when there was incomplete epithelial healing with the presence of 1.5 x 2 mm stromal infiltrate superiorly and 8 x 5 mm stromal edema

Two months later, a paracentral scar was seen and she was prescribed topical Gatifloxacin with Prednisolone 0.5% combination tapered over 2 months and topical Cyclosporine 0.1% BD for 2 months to decrease the scarring and to relieve the dry eye symptoms post-PRK. Anterior segment – Optical Coherence Tomography (AS-OCT) was done which showed post – PRK corneal ectasia and scar formation (Figure 4). Three months later her best corrected visual acuity improved to 6/6 with best correction of +1.75 cylindrical power at 80-degree axis in the RE with a 4 x 2 mm nebular-macular paracentral scar (Figure 5).

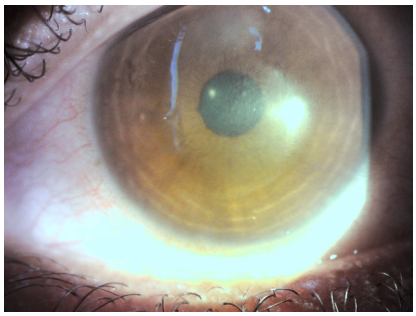

Figure 3A

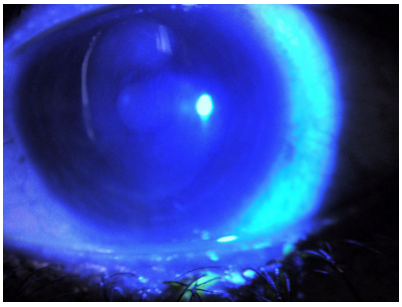

Figure 3B

Figure 3: Visual acuity improved to 6/24 in the RE and best corrected vision of 6/9

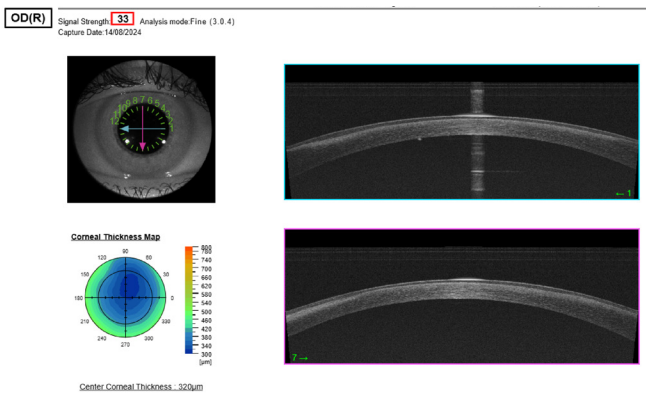

Figure 4: Anterior segment – Optical Coherence Tomography (AS-OCT) showed post – PRK corneal ectasia and scar formation

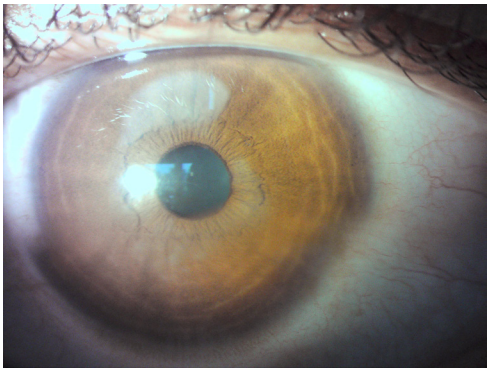

Figure 5: Three months later, visual acuity improved to 6/6 with the correction of +1.75 cylindrical power at 80-degree axis

Discussion

Excimer laser–based corneal surgery is a cornerstone of kerato-refractive procedures, including PRK, LASIK, and LASEK. Among these, infectious keratitis following PRK is a rare but serious complication that can lead to substantial loss of visual acuity in eyes with good visual potential.[i1]

In contrast to LASIK, surface ablation techniques create a significant epithelial defect, facilitating microbial adhesion and proliferation. The use of topical corticosteroids and bandage contact lenses (BCLs) to promote healing may further suppress local immune defenses, increasing the risk of infection. Microbiological evaluation with culture and sensitivity testing is mandatory in all cases, either by scraping from the epithelial defect or the BCL.[ii2]

Early-onset infectious keratitis is most commonly caused by gram-positive bacteria such as streptococci and staphylococci, while gram-negative organisms are less frequently involved. Late-onset cases, on the other hand, are more often associated with opportunistic pathogens, including Nocardia, fungi, and atypical mycobacteria.[2]

Management of early-onset keratitis involves prompt and aggressive treatment with topical fluoroquinolones, such as moxifloxacin 0.5%, levofloxacin 0.5%, or ofloxacin 0.3%. In cases involving methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin is used. Adjunctive therapy with oral doxycycline (100 mg twice daily) can help inhibit collagenase activity, topical corticosteroids is discontinued. Early diagnosis and appropriate treatment are critical for achieving favorable visual outcomes.[3-6]

Conclusion

Infectious keratitis in a patient post-PRK should be treated early and aggressively with antibiotics and later steroids for good prognosis. Potential risk factors for keratitis following surface ablation include blepharitis, exposure to healthcare environments, and contact lens handling. Prompt recognition, proper microbiological evaluation, and intensive antimicrobial treatment are essential for achieving good vision.[1]

Conflict of Interest

The authors declare that they have no conflicts of interest.

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Case Report

Spontaneous 90° Rotation of a Toric Intraocular Lens in Congenital Aniridia: A Surgical Challenge

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Abstract

Purpose: To report a rare case of spontaneous 90° rotation of a toric intraocular lens (IOL) in a patient with congenital aniridia and highlight the importance of capsular support.

Methods: An 18-year-old female with bilateral congenital aniridia presented with cataract. The left eye underwent phacoemulsification with toric IOL implantation without a capsular tension ring (CTR).

Results: On postoperative day 1, the toric IOL showed spontaneous 90° rotation from the intended axis, resulting in significant alteration of astigmatic correction. The case highlighted capsular instability in the absence of CTR.

Conclusion: Eyes with congenital aniridia are at high risk of zonular weakness and IOL instability. Use of CTR is crucial in maintaining rotational stability of toric IOLs and optimizing postoperative outcomes.

Keywords: Congenital aniridia, toric intraocular lens, capsular tension ring, IOL rotation, cataract surgery

Introduction

Congenital aniridia is a rare disorder characterized by the partial or complete absence of the iris and is frequently associated with cataract, foveal hypoplasia, limbal stem cell deficiency, and zonular weakness.[1] Cataract surgery in these patients is challenging due to compromised capsular and zonular support.

Toric intraocular lenses (IOLs) are widely used for the correction of corneal astigmatism; however, their success depends on precise alignment and rotational stability. Even minor postoperative rotation can significantly affect visual outcomes. Eyes with inherent zonular weakness, such as those with aniridia, are particularly prone to IOL instability.

We report a rare case of spontaneous 90° rotation of a toric IOL on the first postoperative day.

Case Report

An 18-year-old female presented with bilateral blurring of vision. On examination:

- **Right eye (OD):** BCVA 6/60 with posterior subcapsular cataract (Figure 1).
- **Left eye (OS):** Vision limited to hand movements with total mature cataract (Figure 2).
- **Both eyes:** Congenital aniridia.

Anterior segment evaluation revealed a clear cornea and absent iris tissue in both eyes. Fundus examination was within normal limits.

The patient underwent phacoemulsification with toric foldable IOL implantation in the left eye under topical anesthesia. No capsular tension ring (CTR) was used intraoperatively.

Postoperative Findings

On postoperative day 1 (Figure 3).

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- The toric IOL was found to have rotated spontaneously by 90° from its intended axis
- A marked change in refractive cylinder was noted
- No signs of inflammation or capsular compromise were present

Keratometry Readings

- K1: 40.50 D @ 171°
- K2: 42.50 D @ 81°

Refraction

- Preoperative: −2.00 D @ 81°
- Postoperative: −4.75 D @ 172°

The patient was kept under close follow-up and advised regarding further intervention.

Discussion

Toric IOLs require precise alignment, as each degree of misalignment results in approximately 3.3% loss of astigmatic correction. A 90° rotation leads to complete loss of intended effect and may worsen refractive error.

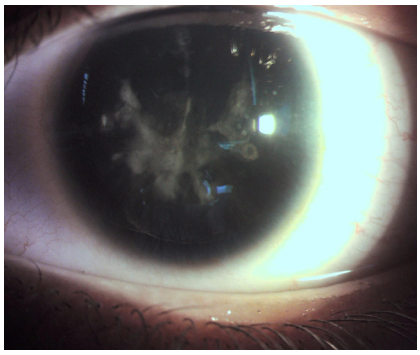

Figure 1 : OD showing Posterior sub capsular cataract with aniridia

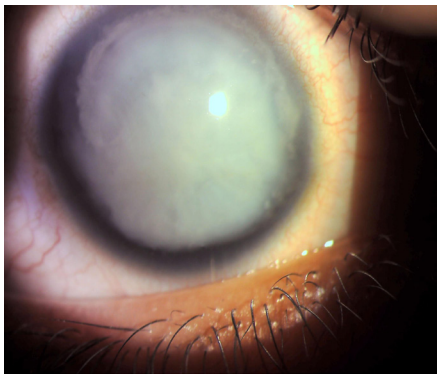

Figure 2 : OS showing Mature cataract with aniridia

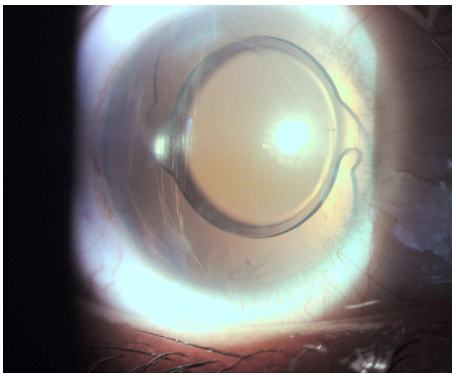

Figure 3 : Post op day 1

Congenital aniridia presents several intraoperative challenges:

- Zonular weakness
- Capsular bag instability
- Increased risk of IOL decentration and rotation

Capsular tension rings (CTRs) are designed to stabilize the capsular bag by evenly distributing zonular forces, particularly in eyes with compromised zonules.[2] In this case, the absence of CTR likely contributed to early postoperative IOL rotation.

Previous studies have emphasized the role of CTRs in improving capsular stability and preventing IOL-related complications in complex cases.[2] Given the structural abnormalities in aniridia, prophylactic CTR implantation should be considered.

Management options include early IOL repositioning and secondary stabilization procedures.

Conclusion

Cataract surgery in congenital aniridia is associated with significant challenges due to zonular and capsular abnormalities. This case highlights a rare but important complication of early spontaneous 90° rotation of a toric IOL.

Routine use of capsular tension rings in such high-risk cases is strongly recommended to ensure rotational stability and optimal visual outcomes.

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Case Report

Unilateral Pharmacologic Mydriasis Following Accidental Ocular Exposure to Tiotropium Bromide: Case Report

Ratnali Gandhi[1], Neha Shilpy[2], Abhishek Chandra[3*], Govind Khalko[2]

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Abstract

Purpose: To report a case of unilateral pharmacologic mydriasis following accidental ocular exposure to tiotropium bromide.

Methods: A 35-year-old male presented with diminished near vision in the right eye. Examination revealed a dilated, non-reactive pupil in the affected eye with otherwise normal ocular findings. There was no history of any topical or oral medication. After a detailed history, it was found that he works in a paint factory. Imaging studies were unremarkable. After a detailed examination, it was found that he was exposed to tiotropium bromide.

Results: A diagnosis of pharmacologic mydriasis was made, and the patient was managed conservatively.

Conclusion: Accidental ocular exposure to tiotropium bromide can cause transient unilateral mydriasis. Awareness of this condition is important to avoid unnecessary investigations and ensure appropriate management.

Keywords: Tiotropium bromide, Pharmacologic mydriasis, Anticholinergic, Unilateral dilated pupil, Ocular exposure.

Introduction

Tiotropium bromide is a long-acting anticholinergic agent commonly used as an inhalational bronchodilator in chronic obstructive pulmonary disease and asthma. Its mechanism involves inhibition of muscarinic receptors, leading to smooth muscle relaxation in the airways.

Ocular exposure to anticholinergic agents can result in pupillary dilation due to blockade of the iris sphincter muscle. Such presentations may mimic serious neurological conditions, including third nerve palsy or acute angle-closure glaucoma. Although reported with other inhaled anticholinergics, isolated cases involving tiotropium are relatively rare.

We report a case of unilateral pharmacologic mydriasis following accidental ocular exposure to tiotropium bromide in a pharmaceutical worker.

Case Report

A 35-year-old male worker by occupation presented with complaints of diminished near vision in the right eye following accidental instillation of tiotropium bromide. The patient denied pain, redness, diplopia, or headache.

On examination, best-corrected visual acuity for distance was 6/6 in both eyes. Near vision was N36 in the right eye and N6 in the left eye. The right pupil measured approximately 6 mm and was non-reactive to light, while the left pupil was normal (Figure 1).

Anterior segment evaluation with slit-lamp examination was unremarkable. Intraocular pressure was within normal limits in both eyes. Fundus examination revealed healthy optic discs and normal macula with preserved foveal reflex.

Optical coherence tomography showed a normal macular contour with an average retinal thickness of 278.5 µm. Extraocular movements were full, and no signs of uveitis or optic neuropathy were observed.

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EXAMINATION

	OD	OS
Visual Acuity by Snellen	6/6	6/6
Near Vision by Jaeger	N36	N6
Conjunctiva	Normal	Normal
Cornea	Clear	Clear
Anterior Chamber	Quiet VH4	Quiet VH4
Pupil	7mm	2mm
Lens	Normal	Normal
Fundus	Normal	Normal

Figure 1: Examination of OD and OS of patient

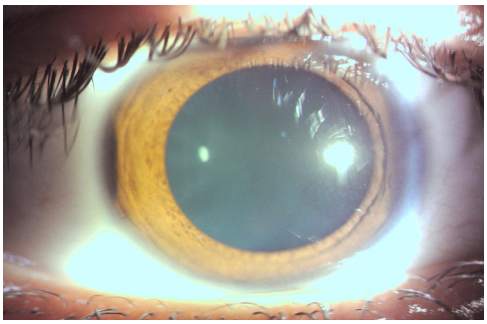

Figure 2: Day 1 of presentation

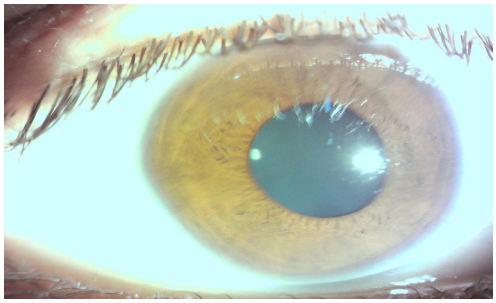

Figure 3: Day 3 of presentation

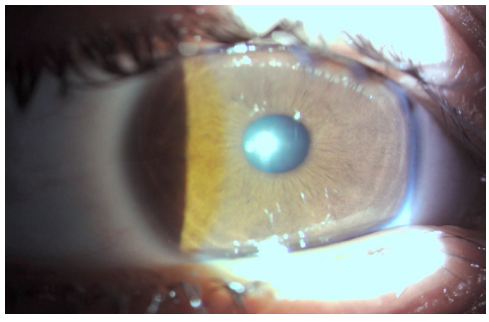

Figure 4 : Day 7 of presentation

Based on clinical findings and history, a diagnosis of unilateral pharmacologic mydriasis secondary to tiotropium bromide exposure was made. The patient was managed conservatively with observation. At follow-up, symptoms improved gradually (Figures 2-4).

Discussion

Pharmacologic mydriasis occurs due to inhibition of parasympathetic innervation to the iris sphincter muscle. Anticholinergic drugs such as tiotropium can induce this effect when they come into contact with ocular tissues.

Unilateral mydriasis requires careful evaluation to rule out life-threatening conditions such as an intracranial aneurysm causing third nerve palsy. However, distinguishing features of pharmacologic mydriasis include the absence of ptosis, preserved extraocular movements, and lack of associated neurological symptoms.

Similar cases have been reported with inhaled anticholinergic agents like ipratropium bromide, where aerosol leakage or improper handling leads to ocular exposure. Occupational exposure, as seen in this case, represents an additional risk factor.

The condition is self-limiting and typically resolves without intervention. Management involves reassurance and observation. Preventive measures include proper drug handling, use of protective equipment, and clear labeling.[1-6]

Conclusion

Accidental ocular exposure to tiotropium bromide can lead to transient unilateral pharmacologic mydriasis with visual disturbance. Recognition of this benign condition is essential to avoid unnecessary diagnostic procedures. Proper awareness and preventive strategies are important, especially among healthcare and pharmaceutical workers.

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Case Report

A Case of Behçet's Uveitis – A Delay in the Diagnosis

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Abstract

Behçet's uveitis is a severe ocular manifestation of Behçet's disease, a chronic, relapsing multisystem vasculitis. It typically presents as bilateral, recurrent, non-granulomatous panuveitis with occlusive retinal vasculitis involving both arteries and veins. Common ocular signs include hypopyon, hemorrhages, vitritis and retinal infiltrates. The underlying pathogenesis involves immune dysregulation in genetically predisposed individuals, often associated with HLA-B51.

Keywords: Behçet's, Vitritis, HLAB51 positive, Tofacitinib

Introduction

Behçet's disease is a chronic, relapsing, multi-systemic inflammatory disorder with a triad of symptoms which include oral ulcers, genital ulcers and uveitis. Uveitis in Behçet's disease is known to be bilateral, recurrent and non-granulomatous, which presents as panuveitis and retinal vasculitis in the eye. It is a potentially blinding condition and hence requires a high degree of clinical suspicion for early diagnosis, coupled with early and aggressive treatment to prevent blindness.[1]

Case Report

A 30-year-old male presented with complaints of diminution of vision in both eyes for 10 days, more pronounced in the left eye, associated with floaters and occasional redness. He reported a history of recurrent oral ulcers over the past 2 years. There was no history of trauma or prior similar ocular episodes. The patient had been previously diagnosed as a case of panuveitis elsewhere and had received oral corticosteroids and posterior sub-Tenon triamcinolone injection.

On examination, the best-corrected visual acuity (BCVA) was 6/60 in the right eye and PL + with inaccurate PR in the left eye. The patient was pseudophakic in both eyes. Pupillary examination revealed a sluggishly reacting pupil in the right eye and a non-reacting pupil in the left eye. Slit-lamp examination showed a quiet anterior chamber in both eyes, with no cells or flare. Intraocular pressure was within normal limits. Gonioscopy revealed open angles. The patient had developed oral ulcers, which pointed towards a presumptive diagnosis of Behçet's disease**.** There was no history of trauma or prior similar ocular episodes. Genital examination was normal.

Posterior segment examination revealed vitritis (4+), along with multiple intraretinal hemorrhages and perivascular sheathing suggestive of retinal vasculitis in both eyes, more severe in the left eye. The optic disc appeared pale.

Color fundus photography was done, which showed dense vitritis with marked media haze and obscuration of retinal details, consistent with severe posterior segment inflammation in the left eye and milder vitritis with visible optic disc pallor and perivascular sheathing of retinal vessels, suggestive of retinal vasculitis in the right eye.

Optical coherance tomography (OCT) was done, which revealed a distorted foveal contour with irregular retinal architecture and hyperreflective intraretinal areas, suggestive of inflammatory retinal involvement in the left eye.

Laboratory investigations revealed positivity for HLA-B51, while other infectious aetiology were ruled out.

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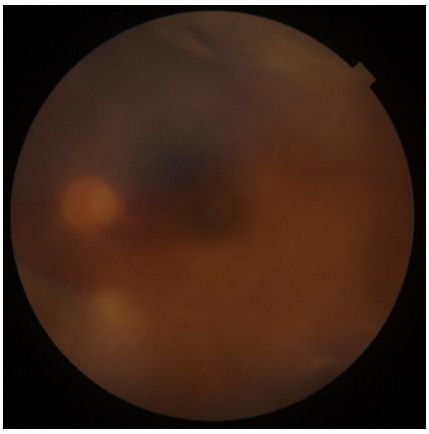

Figure 1: Vitritis of grade IV, presence of retinal hemorrhages along with disc pallor in the left eye

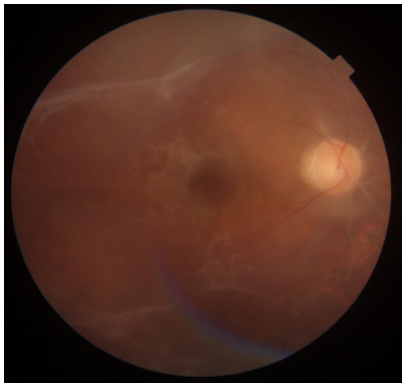

Figure 2: Mild vitritis of grade II with perivascular sheathing and traction bands in the right eye

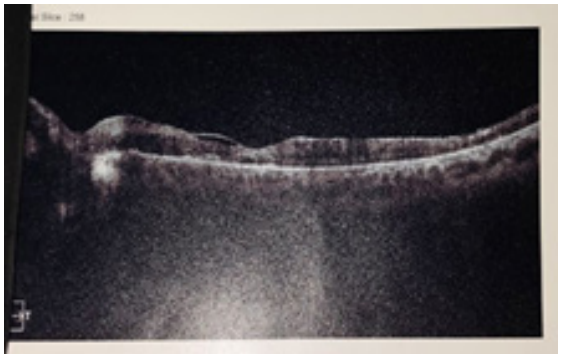

Figure 3: Distorted foveal contour with ERM and hyper reflective echoes in the vitreous

Based on the clinical findings and systemic features, a diagnosis of Behçet's uveitis was established. Following confirmation of the diagnosis, the patient was started on oral methylprednisolone (4 mg), tofacitinib (5 mg), and glutathione supplementation.

Discussion

This case highlights Behçet's disease presenting as posterior-predominant uveitis with a quiet anterior chamber, leading to initial misdiagnosis as panuveitis. The presence of recurrent oral ulcers and HLA-B51 positivity aided in establishing the diagnosis. Significant posterior segment involvement with vitritis, retinal vasculitis, and optic disc pallor underscores the aggressive nature of the disease (Figures 1-4).

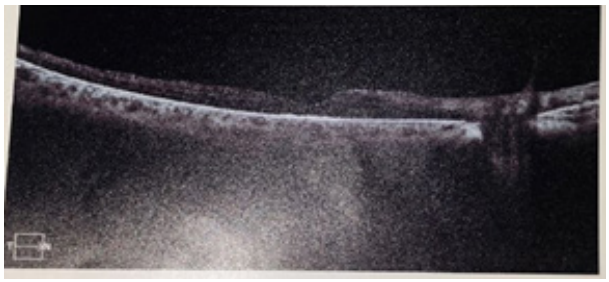

Figure 4: Normal foveal contour with ERM and few hyper reflective echoes in the vitreous cavity

Y. Wang *et al.* published a case of two young male patients presenting with panuveitis and recurrent oral and genital ulcers, who were initially misdiagnosed as Behçet's disease and treated with systemic corticosteroids with suboptimal response. Further evaluation revealed underlying syphilis and HIV infection. Following treatment with penicillin and antiretroviral therapy, uveitis resolved in one patient, while the other was lost to follow-up. This highlights the importance of screening for infectious etiologies in cases mimicking Behçet's disease.[2]

M Jari *et al***.** reported an 11-year-old girl who was initially diagnosed with preseptal cellulitis after presenting with pain and swelling around the left eye. A history of recurrent oral and genital ulcers was noted. On further evaluation, episcleritis and posterior uveitis were identified, and investigations revealed a positive pathergy test and HLA-B51, consistent with Behçet's disease. This case highlighted that ocular manifestations of Behçet's disease may be misdiagnosed due to overlapping clinical features.[3]

Conclusion

Behçet's uveitis is a potentially sight-threatening condition that may be misdiagnosed due to its variable clinical presentation. Ophthalmologists should be vigilant and maintain a high index of suspicion in patients presenting with uveitis, especially when associated with systemic features such as recurrent oral or genital ulcers. Early recognition of characteristic signs and timely initiation of appropriate therapy are essential to prevent irreversible visual loss.

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About the Journal

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