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Highlights:

Assistive technology enhancing the frontiers in visual rehabilitation

A comprehensive colour fundus atlas of retinochoroidal colobomas

Ophtha Courtroom: Lessons from an eye camp

Bilateral Abducens nerve palsy: A rare presentation of Scrub typhus sequelae

An Eye For AI: Insightful visions – AI LLMs in scientific writing

Outcome of Porous polyethylene implants in anophthalmic sockets with implant migration

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Editorial

From practice to publication: Let the wheels turn

Warm greetings from the new editorial board of the Kerala Journal of Ophthalmology (KJO)! It is with great delight and excitement that I present to our esteemed readers the maiden issue of KJO (volume 36 issue 1) put together by the new editorial team.

"Vision is the art of seeing what is invisible to others"
Jonathan Swift

As I take over the reins of this esteemed journal, I express my deep respect to all the Emeritus editors of KJO right from Dr K E Eapen, the founder editor of the Kerala society of ophthalmic surgeons (KSOS) bulletin (1974) to Dr Smita Narayanan (2022). Their collective, painstaking efforts down the decades have nourished the journal's growth to its present stature, attracting submissions from all over the country and beyond. Standing on the shoulders of these illustrious predecessors, it is no wonder that my vision reaches far out into the glorious horizons that await our prestigious journal. Inspired by the vision and rather disappointed by the relatively small number of submissions reaching KJO from our own state at present, the new issue has been reinvented to kindle more widespread interest in academic medicine among ophthalmic practitioners in Kerala. It is well documented that there exists a major divide between the cultures of clinical practice and medical research.[1] The revamped KJO endeavors to cater to the pulse of the practitioner as well as the curiosity of the academic. We have striven to ensure that the matter in the pages truly matters to every discerning ophthalmologist irrespective of whether they are in private practice, institute-based practice, academia, or the corporate sector. As the Journal thus speaks for itself through relevant content in a scientific, yet reader-friendly fashion, it is bound to attract a wider readership. Reading, as we are aware, sparks further curiosity and nurtures scientific temper. Hopefully, over time, these efforts will definitely take us closer to the aspirational goal of promoting publication culture among practitioners making KJO evolve into a platform that authentically reflects the ophthalmic issues, practices, challenges, and possible solutions that are relevant to the health care ecosystem in our part of the world.

"Vision without execution is daydreaming"
Bill Gates

Acting upon this vision, nine new sections are being introduced, each different in content, style, target readership, and the domain addressed. However, they all have in common template styles that are crisp, concise, and in step with the pace of the reading/learning behavior of today's world. Simplicity makes science less intimidating, universally appealing, and more inviting. Hence, the new section formats have been kept deliberately simple without compromising the scientific rigor of the process involved. While original articles and case reports remain the traditional stronghold of the journal, these sections aim to facilitate a robust scientific exchange between the journal and the ophthalmic fraternity at large.

"Just A Minute clinics," "Hindsight," and "KJO videos" are specially designed to kindle interest in clinicians to share original clinical work with peers in a hassle-free, yet scientifically robust manner. Hindsight is a unique section that adapts the principles of the reflective learning model used in education technology[2] to scientific writing. The format provides a deeply reflective reading experience taking the reader through true life stories of "what happened," proceeding on to "so what" and ending with precise takeaways regarding "what next." Similarly, videos are being introduced for the first time in our journal taking into consideration the growing number of visual learners, especially among young ophthalmologists.

"Ophtha court room" and "An Eye for AI" are sections that address domains, which despite their crucial contemporary relevance often fall in the blind spot of most ophthalmologists. Literature suggests that if played well, AI is likely to be a win-win game for all the stakeholders.[3] But to play well, we need to empower ourselves with awareness of how and how not to use AI in ophthalmic practice. "An eye for AI" aims to throw light into exactly these aspects. Similarly, knowledge of basic medicolegal aspects can be a lifesaver for us in times of professional peril. "Ignorantia juris non excusat" is a legal maxim that warns that ignorance of the law is not an excuse[4,5] to escape penalty. "Ophtha court room" is a case-based section being introduced to empower ophthalmologists with essential medicolegal wisdom.

While the aforementioned sections focus on the contemporary, "The Premiere" delves back into history and reminds us of the path-breaking events in the evolution of modern

ophthalmology in a most engaging, creatively scientific manner. "PG capsules" and "Write it right" are sections that offer hand-holding in the domains of academia and research, facilitating "speed geeking" of the most important ideas in the least possible time. "Journal scan" brings "flash news" from the world of research to practitioners, which they may translate judiciously to evidence-based practice.

I profusely thank the section editors who have given me full support in envisaging and launching these new sections. The relevant manuscript templates have been made visible on the KJO website and submissions are open.

"Commitment is an act, not a word."

Jean-Paul Sartre

As my immediate predecessor Dr Smita Narayanan had very aptly put it, KJO as it stands today is every bit a work in progress.[6] As the present editor at the helm, I am guided by the strong conviction that human endeavor in the right direction can bring progress and change the world for the better. However, from behind the shadows, emerges Rumi reminding me nonchalantly that, perhaps in truth, it is the world that ultimately transforms the ones who dream of changing it. Even if it be so, we can and must choose wisely the ways in which the world should change us and define our work. For if we choose right, moulded by the best influences of a rapidly advancing world, we can grind the decadence of mediocrity to dust — be it in academics, research, or clinical practice. Thus driven by a passion for excellence, the new editorial board shall strive to turn the wheels of progress for KJO with utmost commitment. I am hopeful that the collective efforts of my largely young, highly talented, enthusiastic team can definitely propel KJO and the ophthalmic research scene in our state onward to ever-widening horizons.

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Assistive technology enhancing the frontiers in visual rehabilitation



As proponents of modern medicine, we believe that our duty is to treat patients who come to us for their ailments. It is also our understanding that we should educate and motivate the public regarding the importance of early diagnosis of diseases and the good practices to be followed for a healthy life. As ophthalmologists, we even go to the doorsteps of patients to treat them in eye camps. Yet, in our clinical practice, there are times when we are faced with scenarios where we cannot offer a definitive treatment or useful advice. Consider these situations:

- A 40-year-old patient suffering from retinitis pigmentosa with residual central vision only and reports great difficulty in carrying on with his office work.
- A 14-year-old child studying in school with recent onset blurring of vision, diagnosed with Stargardt disease.
- A 5-year-old child with primary optic atrophy in both eyes.

These are examples of patients who come with progressive ocular diseases, mainly with underlying genetic causes, which in many cases are untreatable. Often, we end up informing them that there is not much hope or treatment to offer. When these patients seek advice regarding how to continue with office work, whether a child with Stargardt disease can undergo normal education or a 5-year-old with gross defective vision can attend a normal school, we are bound to answer these patients/parents authentically. We should be able to address their problems effectively. This underlines the necessity of updating our understanding regarding various visual rehabilitation measures and assistive technology currently available to the visually impaired.

In this context, let us go into a few terminologies used commonly. "Visual Impairment" relates to a functional change in visual acuity/fields associated with a visual disorder (e.g., a retinal atrophic scar). Vision impairment occurs when an eye condition affects the visual system and its vision functions.[1] If this impairment affects tasks involving vision like reading, writing, or mobility, we call it a "Visual Disability" and if the disability is significant enough to produce a socio-economic impact in the form of extra efforts needed for daily life, loss of independence, etc., we call it a "Visual Handicap." Unfortunately, a person with visual disability is very often considered as a handicap not only for the affected but also for the family and the society. With the advancement of technology as well as the changes in the mindset of society toward a handicap, the time has come when disability is not really a disability if the person can access the window of new opportunities that have come up for the so-called disabled. This is the context in which we should be talking about the disabled as the *differently abled*.

The landmark Salamanca statement,[2] in which 92 countries (including India) were signatories and a number of NGOs participated, was drawn up in Spain in 1994. It discussed at length the "Right to Education" for the disabled. Many a time, special schools teach differently abled children how to cope with their disability within their limits, but do not expose them to the limitless opportunities that are possible. In the Salamanca statement, "inclusive education" was the keyword for all types of disabilities. Inclusive education requires trained resource teachers in all schools to cater to differently abled children because such children need specialized skill training to make use of assistive devices/technologies. There are also apps in many regional languages, which are supportive of visually challenged children in rural areas. Evidence has shown that assistive technologies play a significant role in enhancing the participation of visually impaired students in extracurricular activities and mould them better for future life roles as adults.[3] One important point to be highlighted is that children or adults with a disease that produces progressive visual deterioration should make it a point to get trained in various assistive technologies when their vision is reasonably good in the earlier years so that even if vision fails in later years, they will be able to cope up with life better.

The term assistive technology is used to describe both hardware and software that enables people with disabilities to utilize technology in a way that improves their quality of life. It is an umbrella term that covers a spectrum of devices, services, and applications. Assistive technology may be broadly classified into[4]:

(i) Traditional (e.g., eyeglasses, prisms, white canes) and
(ii) Mobile IT-based (e.g., navigation devices, text readers, facial recognition software).

Of these, we as clinicians are more familiar with traditional devices like various types of magnifiers, telescopes, etc. Magnifiers, telescopes, glare disability devices, and field expanders still have a role. But as care providers and advisors of the visually disabled, we need to be updated on the recent advances in assistive technology in low vision services as it stands today. Many of us may not be aware of the fact that the smartphones we have (it need not be the latest, costly model) are capable of assisting us and reading out to us WhatsApp messages or contents of a text using various applications available in a smartphone. For the visually challenged, this is a revolutionary help enabling him/her to cope with the visual impairment.

Let us consider some IT-based assistive technology applications available for the visually disabled:

- **TALK BACK:** In the Android phone, there is a provision for *Talk Back* facility. Talk back gives you eyes-free control over your mobile phone. If this setting is activated, once you double tap an icon, e.g., "WhatsApp," it will open and on tapping a message, it will be readout. "Talk Back" is available in the *accessibility* menu in the *settings* icon of Android phones. This type of screen reader service is available in iPhone as a *voice over* facility. If "talk back" is activated in the smartphone, if you tap any icon, the name of the icon will be read out, and if you double tap, it will open the application.
- **INSTA READER:** If you install the *Instareader* app on your mobile, it will help to read out the texts you want to read. Text contents can be captured as photographs too, which the app will read out to you. "Audio books" made with the help of this app could be very useful for students who are visually challenged.
- **COIN READER:** Another useful app for the visually impaired would be the *"coin reader"*, which can be installed into the smartphone. There are various types of *coin readers*. The coin reader recognizes currency denominations and reads them out. This can greatly help the visually impaired recognize the denomination of the rupee notes they have to handle while doing day-to-day cash transactions.
- **NVDA:** A person with visual impairment, working on a desktop or laptop can use "screen reading" by installing the *"Nonvisual desktop access"* (NVDA) facility. This is a free open-source screen reader for "Windows." NVDA allows one to access and interact with the Windows operating system and this will help to read the letters you key in, the words and sentences you create, or other texts you wish to read.
- **SMART VISION GLASSES:** The latest innovation now is the "Smart Vision Glasses," which help very much in the mobility aspect of the visually challenged. It helps to recognize obstacles, thus aiding in navigation, and has even facilities for face reading.

Science and technology are in constant evolution. The technology today is very different from that of yesterday. Tomorrow it will be different and more advanced. These rapid strides in technology have come to be of great assistance to the visually challenged in making life much easier for them. Now, artificial intelligence is poised to become the new game changer. In the coming days, let us hope to witness a revolution, in which the power of AI will be explored fully to offer advanced and practical solutions that will help the visually challenged navigate their lives independently and efficiently.

Sahasranamam V

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Review Article

Imaging in pathologies of extraocular muscles: A pictorial review

ABSTRACT

The extraocular muscles (EOMs) are implicated in a variety of local and systemic diseases. Often, the pattern of disease on imaging, along with the clinical presentation, can lead the ophthalmologist and radiologist toward a specific diagnosis. This article provides a comprehensive pictorial review of common pathologies affecting EOM, with an emphasis on the unique imaging characteristics that help in clinching the diagnosis.

Keywords: Cellulitis, extraocular muscles, Graves' ophthalmopathy, lymphoma, MRI, orbit

INTRODUCTION

Orbital involvement may be seen in a wide spectrum of diseases ranging from infective, inflammatory, traumatic, and neoplastic etiologies to vascular malformations and congenital and idiopathic clinical conditions. Orbital involvement may be isolated or it may be part of a systemic disease. Their clinical features and ophthalmological findings may not always lead to specific diagnoses. In many cases, only a combined clinical or ophthalmological assessment, laboratory tests, and radiological evaluation may lead to a specific diagnosis. Although few diseases require serum markers to confirm diagnosis, magnetic resonance imaging (MRI) plays an important diagnostic role and helps in differential diagnosis because of the proposed diagnostic criterion.

In day-to-day practice, we now come across a lot such cases where multimodality evaluation is needed to reach a final diagnosis and start specific treatment accordingly, so as an ophthalmologist, it has now become important to be familiar with radiological findings, especially those seen on computed tomography (CT) and MRI. Also, since steroids have demonstrated a dramatic role in the treatment of a few diseases, an ophthalmologist should be familiar with radiological findings to avoid delays in diagnosis and treatment.

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DISCUSSION

Various pathologies affecting extraocular muscles (EOMs) are enumerated in Table 1. These pathologies will be discussed under subgroups of conditions that commonly present with similar clinical or imaging appearances, with an emphasis on the specific characteristics of each condition that help in reaching the final diagnosis.

Conditions causing uniform enlargement of EOMs

The main clinical entities in this subgroup are Graves' disease, IgG4 disease, and idiopathic orbital inflammatory

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syndrome (IOIS). Clinically, all these may have overlapping presentations.

Graves' disease is the most common cause of bilateral and unilateral proptosis in the adult age group. There are systemic features such as tremor and weight loss, along with ocular signs such as proptosis, ophthalmoplegia, and lid lag associated with them. IgG4 disease is a recently established systemic disease that commonly affects the head and neck. In orbit, it commonly affects the lacrimal gland, EOMs, and optic nerve. The patient may present with unilateral or bilateral proptosis with ophthalmoplegia. IOIS, the third most common orbital disease, is a diagnosis of exclusion with no identifiable cause. Previously known as orbital pseudotumor, this is now understood to represent a spectrum of inflammatory processes. IOIS can involve any component of the orbit, including EOMs (orbital myositis). IOIS results from a non-granulomatous inflammatory process with lymphocytic infiltration.

In all three of these diseases, MRI findings of signal alteration may be similar. There is an isointense-to-hypointense signal of EOMs on T1-weighted (T1W) and hyperintense or heterogeneous signal intensity on T2-weighted (T2W) images, except for the chronic phase of Graves's ophthalmopathy, where it can be T1 and T2 hyperintense due to fatty replacement. Variable post-contrast enhancement is noted. It is the pattern of involvement of EOMs that is more helpful in differentiating these three. In Graves' disease, the inferior rectus is the earliest muscle involved, and it is also the most commonly involved muscle, followed by the involvement of the medial rectus, superior rectus, lateral rectus, levator palpebrae, and oblique muscles in order. This is in contrast to IgG4 disease, where the lateral rectus is the first and most common muscle to be involved. In this disease, along with EOMs, paranasal sinuses, infraorbital nerves, and salivary glands may also be involved. One more distinguishing feature between the two is that Graves' ophthalmopathy commonly involves muscle belly while sparing tendinous insertion, whereas IgG4 disease equally involves both muscle belly and tendinous insertion [Images 1 and 2]. On CT, the muscles are isodense compared with unaffected muscles, and on MRI, the muscles are isointense on T1 and hypo-isointense on T2 imaging.[1-3] The involvement of the trigeminal pathway has been found to be a useful diagnostic sign for IgG4-related disease; the involvement of the infraorbital nerve has been reported in up to 50% of such cases.[4]

Table 1: Showing etiology of different pathologies affecting extraocular muscles

Pathology	Etiology
Uniform EOM enlargement	1. Graves' disease 2. IgG4 disease 3. Orbital pseudotumor or IOIS
Nonuniform EOM enlargement	Nonneoplastic: 1. Orbital pseudotumor or IOIS 2. Orbital cellulitis and other infections 3. Sarcoidosis 4. Vascular lesions 5. Post-traumatic hematoma Neoplastic: 1. Primary orbital or EOM mass 2. Lymphoma 3. Metastases 4. Extension from adjacent lesions, such as PNS mass
EOM atrophy	1. CPEO 2. CFEO

IOIS or orbital pseudotumor-related myositis also affects the muscle belly of EOMs without sparing tendinous insertion, similar to IgG4 disease. However, here the most common muscle and earliest muscle to get involved are medial rectus followed by the superior rectus, lateral rectus, and inferior rectus. Also, the disease is mostly unilateral. The enlargement of a single EOM with tendon involvement is the most common presentation and is suggestive of the diagnosis [Image 3]. EOM inflammation is usually accompanied by the involvement of orbital fat, lacrimal gland, and optic nerve sheath. Atypical pattern includes multiple and bilateral muscle involvement and sparing of muscle tendon. The atypical pattern is associated with a high risk of recurrence. In many cases, it might be difficult to differentiate between IgG4-related disease and IOIS myositis. Serum IgG4 level may help in

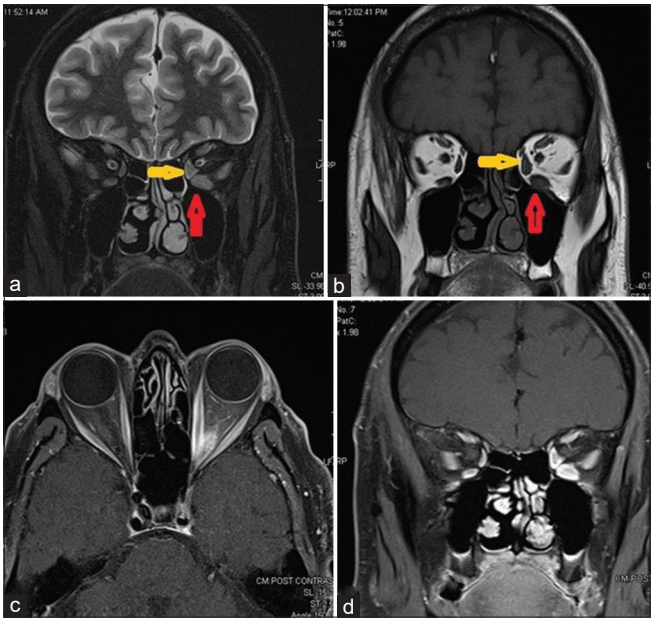


Image 1: (a-d) Thyroid ophthalmopathy—STIR and T1 coronal and axial images of orbit showing enlargement of inferior (red arrow) and medial rectus muscle (yellow arrow) with sparing of tendinous insertion

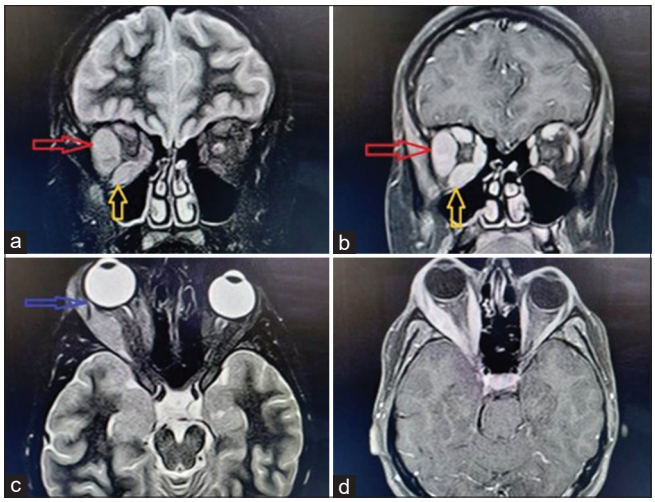


Image 2: (a-d) IgG4 ophthalmic disease—STIR and T1 coronal and axial images of orbit showing enlargement of the inferior (yellow arrow) and lateral rectus muscle (red arrow) with the involvement of tendinous insertion

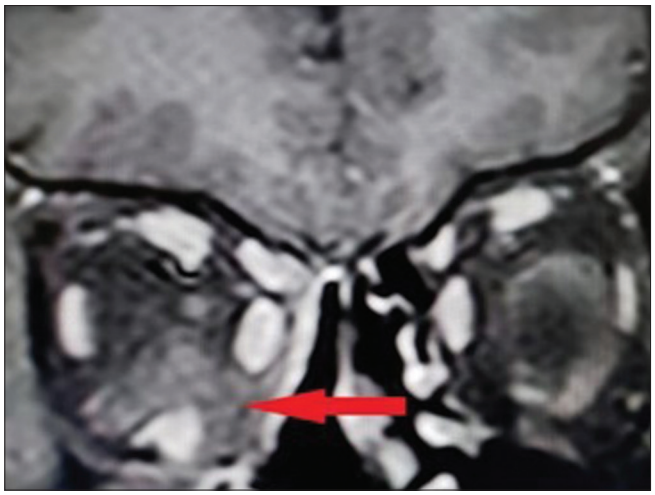


Image 3: Orbital pseudotumor—coronal post-contrast T1W images showing the ill-defined area of intra- and extraconal fat inflammation surrounding the right inferior rectus muscle (red arrow)

such cases; otherwise, invasive tests such as biopsy may be required in difficult cases. Significant initial clinical improvement in response to corticosteroids provides further confirmation.[1-3]

Conditions causing nonuniform enlargement of EOMs

These can be categorized as nonneoplastic and neoplastic lesions. Nonneoplastic lesions include orbital pseudotumor or idiopathic orbital inflammation, orbital cellulitis and other infections, sarcoidosis, vascular lesions, and post-traumatic hematoma. Neoplastic lesions may be in the form of a primary orbital mass, lymphoma, metastases, or extension from adjacent lesions such as paranasal sinus mass.

All of these conditions present with proptosis with periorbital fullness with or without pain. These conditions require a timely diagnosis for optimally tailored management and a better prognosis. Clinically, there is overlap in the presentation of these entities, and imaging studies are required for differentiation, which is essential for treatment planning. CT and MRI both are helpful, with CT being more helpful in traumatic lesions and where bony details are sought, while MRI is more helpful where soft tissue evaluation is the main concern. Even on conventional MRI, there is considerable overlap in many of these entities, making a definitive diagnosis without pathological specimens difficult. Therefore, it is clinically useful to have a noninvasive method such as MRI diffusion-weighted images (DWIs) to distinguish between these. There is greater diffusion restriction in lymphoma than in orbital pseudotumor or cellulitis. Also, the orbital pseudotumor is significantly brighter on DWI than on cellulitis.

On imaging, IOIS can demonstrate a focal intra-orbital mass or a diffusely infiltrating lesion similar in appearance to lymphoma [Image 3]. The lacrimal gland, optic nerve sheath complex, uvea, and sclera can all be involved. IOIS appears T1 and T2 hypointense on MRI. MRI DWI has been investigated for the workup of indeterminate orbital masses. In general, malignant lesions such as lymphomas have been found to have lower apparent diffusion coefficient (ADC) values in comparison with benign lesions, which is particularly relevant when assessing infiltrative lesions that are hypointense on T2W imaging.

Orbital infections leading to orbital cellulitis can result from multiple causes, such as infections of paranasal sinuses, dental abscess, post-trauma, periocular surgery, and septicemia, with sinusitis being the most common preceding event. Immunosuppression is an important predisposing factor. Parasitic orbital infections can be considered a separate category as these may remain localized, and presentation may be different from orbital cellulitis. Orbital cellulitis is usually unilateral. Imaging studies help in making diagnoses and also detecting complications such as abscess (subperiosteal, intraconal, or intracranial), thrombosis of the superior ophthalmic vein, and cavernous sinus. CT scan of the orbit is the initial imaging modality of choice as it is widely available and can be done rapidly. Changes can be seen as soft tissue stranding in orbital fat (intraconal or extraconal) with bulky hypodense EOM or peripherally enhancing necrotic lesions or abscesses in muscle. On MRI, there may be T2 hyperintensity of the intra-orbital fat and EOM with variable post-contrast enhancement. Diffusion restriction can be seen if an abscess develops. The medial rectus is most frequently involved due to its proximity to the ethmoid sinus. Preceding clinical history and imaging findings as extensive multi-compartmental inflammatory changes and

complications such as abscesses help to differentiate it from IOIS and IgG4 disease.[2,3,5-7]

Orbital hematomas may be confined to one muscle, and they may be multi-compartmental. Hematomas of EOMs may be post-traumatic or even spontaneous, which may be seen in the elderly with hypertension. Appearance is distinct on CT as bulky muscle with a hyperdense (acute) or isodense lesion (subacute) on non-contrast images and no post-contrast enhancement [Image 4]. In the appropriate clinical setting, non-contrast CT is enough to make a diagnosis of hematoma along with the delineation of fractures in bony walls if any. On MRI, appearance is also characteristic of susceptibility-weighted images showing dark signals or blooming artifacts. The fluid level may also be visualized.[8]

As far as the neoplastic involvement of EOMs is considered, rhabdomyosarcoma is the most common primary malignancy. Involvement in lymphoma is usually part of disseminated disease; however, primary orbital lymphoma may also be seen. Metastatic involvement is usually part of bony orbital metastasis with an extension to involve EOM. EOM metastases are most commonly from cutaneous melanoma, followed by breast cancer, carcinoid tumor, and lung and prostate cancer. On imaging, orbital metastases can appear diffuse and irregular and can grow along the rectus muscles and fascial planes. Features such as infiltrating margins and bone destruction favor malignant neoplastic etiology with dominant soft tissue mass in favor of rhabdomyosarcoma [Image 5] and epicenter in the bony wall suggesting metastatic disease or extension from the primary bone tumor.[9-11] It is lymphoma where a significant overlap is found with other entities such as inflammatory lesions of the orbit (IOIS, IgG4 disease, and granulomatous disease or sarcoidosis).

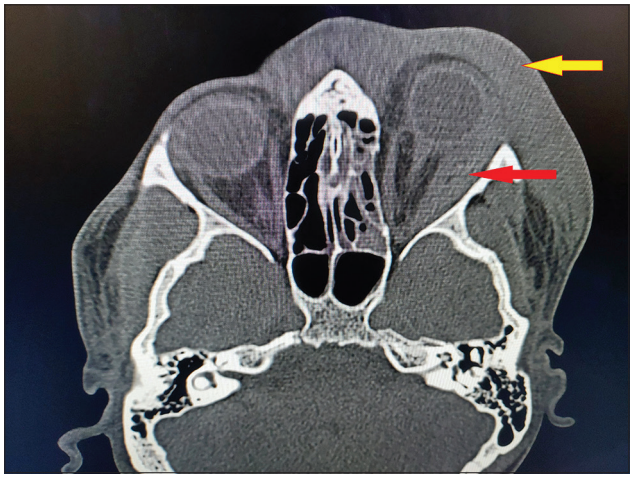


Image 4: Axial non-contrast CT images showing hematoma in left lateral rectus muscle (red arrow) with preseptal edema (yellow arrow)

Unlike inflammatory lesions, orbital lymphoma often presents with painless proptosis. Differentiation between lymphoma and IOIS is important given the different treatments and prognosis of lymphoma and IOIS. EOM lymphoma appears hyperdense on CT, with mild-to-moderate enhancement after contrast administration. Although CT is sensitive to both lymphoma and inflammatory lesions or orbital myositis, it usually cannot differentiate between the two. On MRI, lymphoma appears to have intermediate signal intensity to hypointensity on T1W and T2W images because of the high nucleus-to-cytoplasm ratio and demonstrates homogeneous post-contrast enhancement. DWI is useful in differentiating orbital lymphoma from inflammatory lesions. Lymphomas tend to show brighter signals on DWI and lower ADC as compared to normal orbital structures, whereas inflammatory lesions tend to show intermediate signal intensities on DWI and ADC.[10] The involvement of preseptal orbital space is also characteristic of lymphoma and useful in differentiating it from IOIS. Ren *et al.*[11] in their study found MRI features such as involvement of preseptal orbital space and 10th percentile ADC values to be most helpful in differentiating lymphoma from IOIS.

Vascular lesions of the orbit usually have a distinct clinical presentation in the majority of cases, and in most cases, diagnosis can be achieved with the combination of clinical presentation and imaging findings. These entities include orbital hemangioma, lymphangioma, and carotid-cavernous fistula (CCF). Orbital hemangiomas and lymphangiomas can involve EOMs, leading to their enlargement. In CCF, EOM enlargement is usually secondary to vascular congestion. Multiphasic contrast-enhanced CT (CECT) or MRI should be performed if vascular lesions are suspected; these modalities will also detect or rule out other possibilities. On imaging studies, the diagnosis of CCF is obvious based on the dilated patent superior ophthalmic vein, cavernous sinus, and other veins due to arterialized flow. Fistulous communication can also be visualized, and in difficult cases, digital subtraction angiography (DSA) may be required to delineate the exact site of fistulous

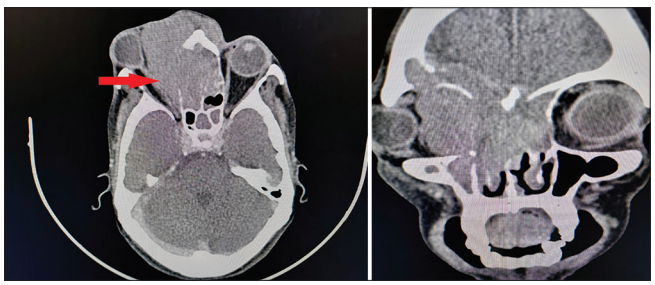


Image 5: Rhabdomyosarcoma—post-contrast axial and coronal computed tomography images showing mild homogenously enhancing mass lesion involving the right medial rectus muscle with the involvement of right frontal, ethmoid sinuses, and nasal cavity

communication. Capillary hemangiomas may show solid homogeneous enhancement, while cavernous hemangiomas are characterized by peripheral nodular enhancement in the early phase and progressive centripetal enhancement in later phases. Venolymphatic malformations are characterized by insinuating patterns of extent and may show fluid levels, variable post-contrast enhancement, and phleboliths in venous components. Orbital varices have a distinct appearance of dilated venous channels and usually do not cause EOM enlargement.[12]

Condition causing atrophy of EOMs

Chronic progressive external ophthalmoplegia (CPEO) and congenital fibrosis of EOM (CFEOM)

Chronic progressive external ophthalmoplegia (CPEO) is characterized by bilateral ophthalmoplegia with ptosis with or without diplopia. It is usually bilateral and symmetrical; however, asymmetrical presentation is not uncommon with diplopia. On MRI, there is a hyperintense signal of EOM on T1W images in the absence of inflammation, which is typical. The severity of ophthalmoplegia is disproportionate to the reduction in the volume of EOMs; EOMs may show normal to minimally decreased volume. The bright internal signal on T1W images has also been observed in CFEOM, but here, there is a smaller EOM volume with selective atrophy of the superior rectus and levator complex. Myasthenia gravis is another condition that presents with ptosis and diplopia; however, it is characterized by uniform atrophic changes in all EOMs[13,14] [Images 6 and 7].

Isolated EOM atrophy is also seen in many cases apart from generalized atrophy. Abducens nerve palsy is the most common isolated ocular nerve palsy. Central involvement, manifesting as unilateral or bilateral palsy, occurs in brainstem gliomas. Isolated paralysis also occurs in diabetes mellitus, head trauma, multiple sclerosis, and metastatic disease, as well as after a viral illness, especially in the pediatric age group [Image 8].

Miscellaneous Infections involving EOM (other than common orbital cellulitis) --- Infections that can involve orbit/or EOMs are tubercular, fungal, or parasitic.[3,15-17] Parasitic infections are mostly myocysticercosis appearing as cystic lesions with scolex within. Orbital hydatid cyst is rare; it is usually seen as a multiloculated cystic lesion. Orbital tuberculosis is rare. Tubercular infections can cause abscess formation, which is mostly associated with pain and tenderness [Image 9].[15] Fungal infections are usually associated with simultaneous sino-nasal involvement [Image 10]. If associated brain involvement is there, some imaging findings can help in differentiating them. Tubercular abscesses show restricted diffusion in the central portion, while fungal abscesses show it in their wall. On MR spectroscopy, tubercular lesions have lipid peaks, while fungal lesions show amino acid peaks.[15-17] In imaging studies, it is important to look for whether the disease is confined to pre-septal or post-septal space, or both

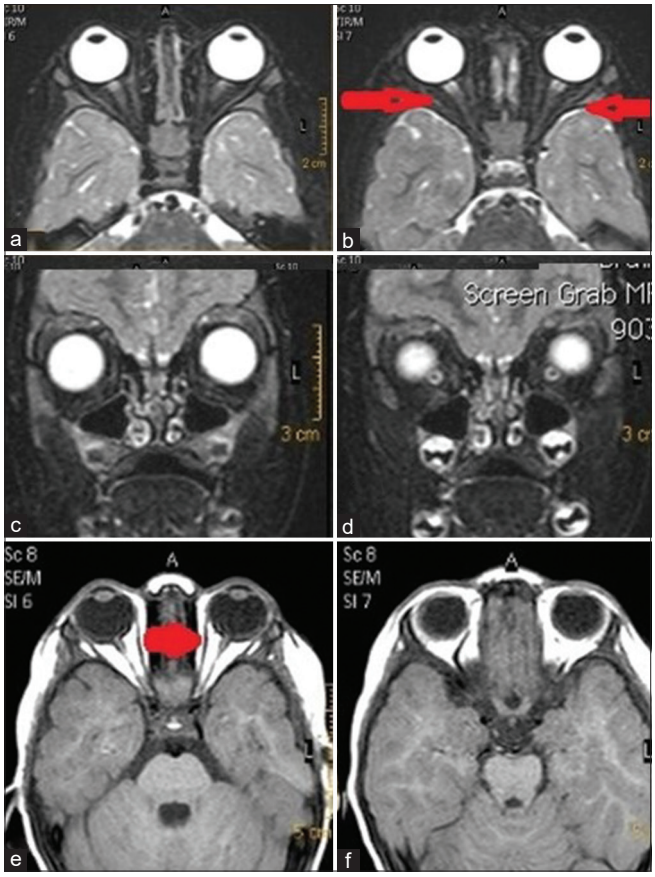


Image 6: (a-f) Congenital myasthenia gravis—axial and coronal STIR, T2, and T1W images of orbit showing uniform atrophy of bilateral extraocular muscles (red arrow)

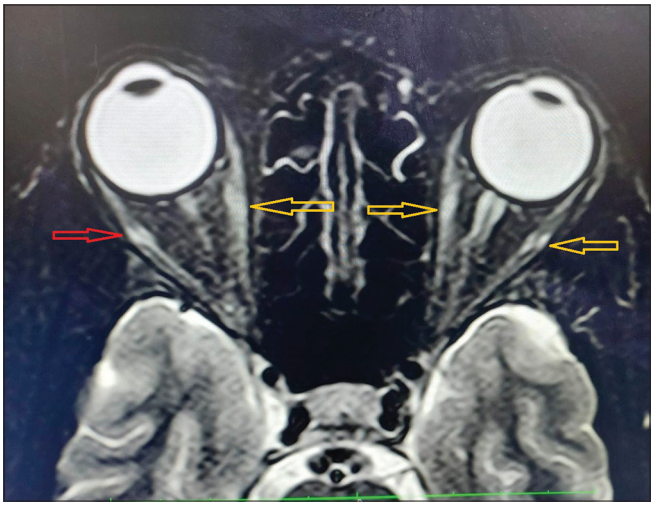


Image 7: Axial STIR image showing mild atrophy of extraocular muscle with hyperintense signal in the mid-portion of bilateral medial and lateral rectus muscle (red arrow)



Image 8: Axial and coronal T1, T2, and STIR images showing atrophy of bilateral lateral rectus muscle (red arrow) in the infant following viral illness causing bilateral abducens nerve palsy

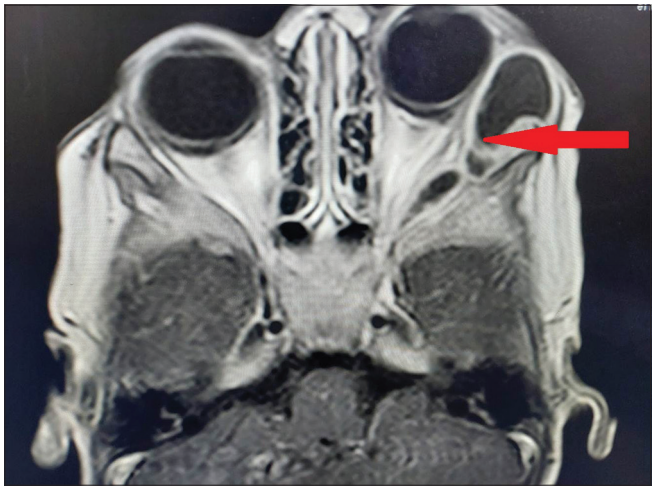


Image 9: Tubercular abscess—axial post-contrast T1W image showing subperiosteal abscess abutting the left lateral rectus muscle (red arrow)

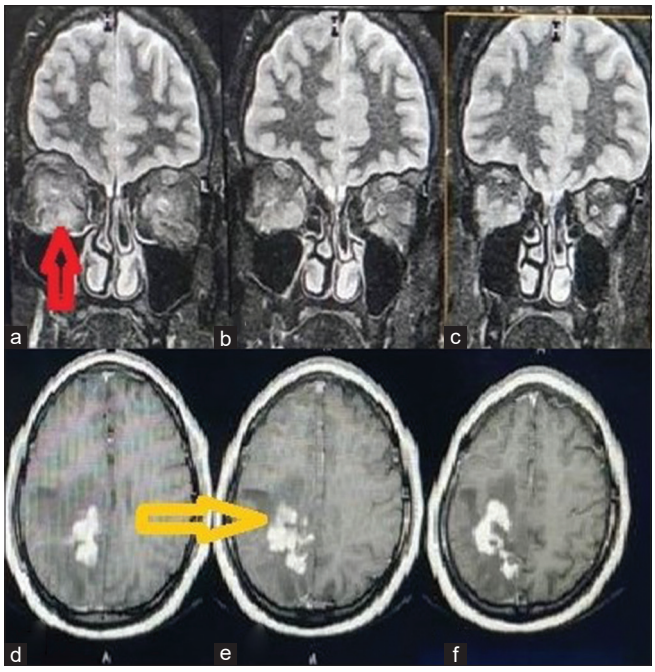


Image 10: (a-f) Fungal myositis— STIR coronal image of orbit showing bulky right inferior rectus muscle with hyperintense signal (red arrow). Post-contrast T1W images of brain showing conglomerated irregular nodular and plaque-like lesions in the right parietal lobe with irregular enhancing margins (yellow arrow)

spaces, as the involvement of post-septal spaces entails more aggressive management, including surgical intervention.

CONCLUSION

The EOMs are involved in a variety of disease processes with characteristic findings on imaging. The pattern of EOM disease on imaging, in corroboration with clinical findings, can often lead the ophthalmologist and radiologist toward a specific diagnosis.

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Conflicts of interest

There are no conflicts of interest.

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Strikingly similar, sparingly same; stromal keratitis

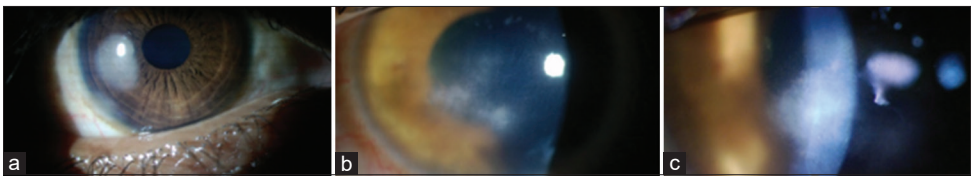


Figure 1: (a): Slit lamp photo showing stromal haze and edema in a case of viral stromal keratitis, (b): Slit lamp image of mid to deep stromal edema and haze in a biopsy-proven case of microsporidial stromal keratitis. (c): Progression of keratitis with the appearance of granularity within the stromal keratitis and extension to deep stroma in the same patient

These are color photographs of two cases of stromal keratitis. The first case [Figure 1a] responded to a course of topical antiviral and steroid drops. The second case [Figure 1b] showed a poor response to the same regimen with progression [Figure 1c]. On further evaluation, the patient reported a history of being treated with similar treatment on multiple occasions over the previous eight months. What would you consider as the next line of management in the second case?

1. Change the route of antiviral.
2. Increase the dosage of steroids.
3. Corneal smear or biopsy.
4. Initiate a dose of intrastromal voriconazole.

Choice: 3 Corneal Biopsy

Depicted here are visually similar but etiologically diverse conditions causing stromal keratitis. On cursory examination, the conditions may appear identical, but nuances within the lesion reveal significant differences with diametrically opposite responses to management. Although examination might initially categorize all these pictures within the same clinical spectrum, the underlying etiology remains diverse.

The first picture [Figure 1a] with the stromal haze and edema is a typical case of viral keratitis. Subsequent images, though similar in appearance on cursory examination, are cases of microsporidial keratitis [Figure 1b and 1c].

Though not uncommon, microsporidial keratitis is an underdiagnosed condition in our population. Stromal keratitis often occurs as a sequela of keratoconjunctivitis, presenting a clinical picture similar to adenoviral keratoconjunctivitis. The hallmark feature is the presence of "stuck-on" [Figure 2a] superficial punctate keratitis with minimal subepithelial or stromal involvement. Commonly seen during the rainy season,[1] it is a self-limiting condition but can progress to intractable stromal keratitis due to local and systemic immunosuppression. Misdiagnosis and injudicious use of steroids are among the common reasons for local immunosuppression leading to stromal keratitis.

Clinicians should suspect microsporidial keratitis when considering the following etiological and clinical features:

- Exposure to contaminated water or soil.[2]
- History of long-term treatment of viral keratitis with waxing and waning response or poor response to steroids.[3]
- Prolonged course with keratitis, often treated by multiple clinicians.
- Nonresolution and persistent stromal keratitis with slow progression despite topical antiviral and steroid treatment.

Previous case series have shown that the average period before considering microsporidia as a causative organism is more than 6 months to a year.[4] As the organism is intracellular and not amenable to culture, a corneal smear or biopsy is required for confirmation of diagnosis. Medical management has been tried with topical voriconazole, itraconazole, fluroquinolone, fumagillin, and oral albendazole. Medical management often fails, and eventually, most cases require surgical intervention in the form of therapeutic keratoplasty.[3]

The patient depicted in the color plate was treated as a case of viral keratitis for over 8 months with topical antiviral and steroids. The subsequent color plate shows the corneal biopsy from the same patient, revealing the presence of multiple discrete rice bodies within the corneal lamellae [Figure 2b, 2c]. The patient eventually required therapeutic keratoplasty.

A delayed or poor response to steroids in the case of routine stromal keratitis should prompt the clinician to reconsider the initial diagnosis and consider microsporidial keratitis as a differential diagnosis.

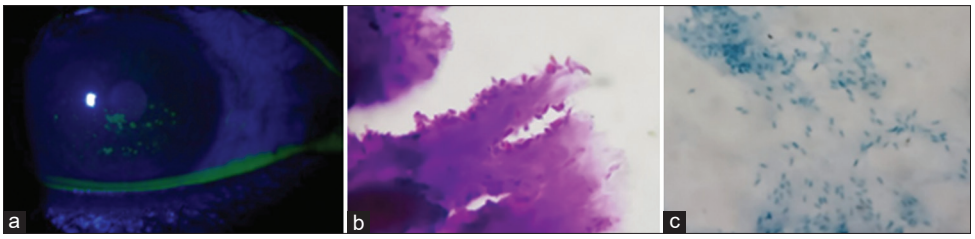


Figure 2: (a): Slit lamp photo after fluorescein staining in a case of microsporidial keratoconjunctivitis with typical "stuck on" appearance of superficial punctate keratitis. (b) and (c) Histopathology from the stromal keratitis patient showing the presence of multiple discrete rice-like oval bodies within the entire corneal lamellae

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There are no conflicts of interest.

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Lessons from an eye camp

INTRODUCTION

Many of us think that eye camp offers free treatment and will not come under the Consumer Protection Act (CPA). Actually, only services provided free for everyone are excluded from CPA. Even government hospitals where as low as 5 Rs is charged as a registration fee or a camp where some people are charged do come under CPA.

CASE SCENARIO: SALIENT POINTS AND DEFENCES

The State Consumer Disputes Redressal Commission in Kerala, India, heard a case between Hospital X and a patient named Thankamma.[1] Thankamma, a 65-year-old woman, alleged negligence and deficiency in service by the hospital, claiming to have lost vision in her left eye after undergoing cataract surgery there. According to Thankamma, she attended an eye camp conducted by Hospital X in Thiruvananthapuram, where she was diagnosed with cataract and advised to undergo surgery. She underwent the surgery at the hospital on July 5, 2002, but experienced intense pain in her left eye and ultimately lost vision in that eye. Thankamma attributed the loss of vision to the carelessness and negligence of the hospital's doctors. Hospital X admitted that the surgery was conducted as alleged and that the patient had signs of postoperative infection. They argued, however, that the infection was not a result of negligence but was treated appropriately. They claimed that the patient's own hygienic habits might have contributed to the infection and denied any negligence on their part. The case hinged on the expert report submitted by Dr. IP, who examined the hospital records. Dr. IP concluded that the patient did not actually require cataract surgery and that it was an untimely procedure. He also noted the lack of preoperative administration of antibiotics, which is a standard practice in eye surgeries. The hospital contested Dr. IP's findings and cited alternative medical literature to support their position. The State Consumer Disputes Redressal Commission relied on Dr. IP's report, which stood unchallenged as the expert was not examined in court. The commission found that the hospital's negligence in not administering preoperative antibiotics and their failure to provide evidence of proper sterilization and hygiene protocols contributed to the patient's condition. They upheld the previous order for the hospital to pay compensation and costs to Thankamma.

TAKE HOME MESSAGES

1. Camp cases are not immune to consumer litigations.
2. Always follow the standard practice for cataract surgery with evidence from the literature. In this case, fault was found with not prescribing preoperative antibiotics. This currently has low evidence. It is better to follow the standard textbooks or guidelines by the Government or professional societies. Each hospital/surgeon can have their protocols, provided they are supported by scientific evidence and it is the standard of care. When contesting a case support your actions with evidences are observed.
3. Always keep a record of the sterilization protocols and submit them to the court in the lower court itself. Document the instructions given to the patient properly.
4. Expert opinions can be detrimental to the doctor. So, it can be challenged and expert can be examined in the court. Usually, the court will allow expert opinion only when it feels so. In cases of obvious negligence, judiciary will not give permission for expert witness or medical board.

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Conflicts of interest
There are no conflicts of interest.

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Original Article

Correlation of diurnal fluctuations in intraocular pressure and progression of chronic simple glaucoma

ABSTRACT

Purpose: To study the correlation between diurnal fluctuations of intraocular pressure and progression of chronic simple glaucoma. **Introduction:** Out of all the risk factors for glaucoma, only modifiable risk factor is intraocular pressure. A lot of studies have been done to determine the relationship between the behavior of diurnal intraocular pressure (IOP) and progression of glaucoma. The results varied and are inconclusive because the visual field damage could have occurred at a time when the IOP was high, although it was low at the time of measurement. **Materials and Methods:** A prospective study was conducted on all patients diagnosed or suspected CSG with office IOP <25 mmHg. Measurement of diurnal fluctuation in IOP was done by taking 2 hourly IOP readings after admitting patients in hospital for 1 day. **Results:** The mean baseline diurnal fluctuation of our patients was 8.5 mmHg with values reaching as high as 13.6 mmHg in some patients. 28.8% of the patients of our study group showed progression at the end of 2-year follow-up. As the baseline diurnal fluctuation increased, the number of patients showing progression increased.

Keywords: Diurnal fluctuation, glaucoma, intraocular pressure, visual fields

INTRODUCTION

Chronic simple glaucoma or primary open-angle glaucoma (POAG) is the most prevalent type defined by its characteristic visual field defects and optic disc changes, with raised intraocular pressure (IOP) being the most common risk factor.

Blindness resulting from glaucoma is irreversible once it has occurred. However, if diagnosed in early stages, it can be prevented, hence the need for early diagnosis and treatment.

Among the various known risk factors for glaucoma, IOP is the only controllable variable, and the reduction of IOP remains the mainstay of preventing progression of glaucoma. However, in a significant proportion of patients, the visual field continue to deteriorate in spite of an apparently controlled IOP.[1]

BACKGROUND

Approximately 16% of all patients with otherwise characteristic POAG have IOPs consistently below 22 mmHg (normal tension glaucoma), and the majority of patients with IOP >21 mmHg do not have glaucoma (ocular hypertensives).

Variations in IOP were first measured by Sidler–Huguenin in 1898. He measured the IOP in 10 glaucomatous patients with the use of digital tonometry and reported that the pressure peaked at night before going to sleep and in the morning 30–60 min after waking.[2]

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Table 1: Extent of optic nerve head changes in the study population

c:d ratio	Number of patients	Percentage of study population
0.3-0.4	10	16.9
0.5-0.6	27	45.8
≥0.7	22	37.3

Table 2: Distribution of intraocular pressure value, AD, and pattern defect in the study population

Baseline corrected IOP range (mmHg)	Number and percentage of study population (%)	AD (dB)		PD (dB)	
		Range	Mean	Range	Mean
10-14	17 (28.8)	-13-19.6	−14.8	5.65-12.88	9.8
15-19	34 (57.6)	-11.19-−23.4	−18.9	4.86-11.6	8.1
20-24	8 (13.6)	-12-−18.4	−16.3	3.24-9.59	5.9

IOP – Intraocular pressure, PD – Pattern defect, AD – Average defect

Table 3: Peak intraocular pressure, trough intraocular pressure, and diurnal fluctuation of intraocular pressure in the study population

Baseline corrected IOP range (mmHg)	Peak IOP (mmHg)		Trough IOP (mmHg)		Baseline diurnal fluctuation (mmHg)	
10-14	14.6-26.4	22.4	9.4-15.9	13.2	4.5-12.4	8.0
15-19	15.9-28.4	24.7	10.2-17.2	14.2	3-13.6	8.7
20-24	15.9-26.2	22.8	12.2-18.9	15.4	4.4-107	8.4

IOP – Intraocular pressure

Table 4: Timing of peak intraocular pressure

Timing of peak IOP	Number of eyes (%)
Morning (8 am-12 noon)	28 (47.46)
Afternoon (2 pm-6 pm)	11 (18.6)
Night (8 pm-10 pm)	16 (27.1)
Plateau	4 (6.78)

IOP – Intraocular pressure

Table 5: Timing of trough intraocular pressure

Timing of trough IOP	Number of eyes (%)
Morning (8 am-12 noon)	8 (13.5)
Afternoon (2 pm-6 pm)	21 (35.6)
Night (8 pm-10 pm)	26 (44.1)
Plateau	4 (6.78)

IOP – Intraocular pressure

Table 6: Patients showing progression

Baseline diurnal fluctuation range (mmHg)	Number of eyes showing progression	
	Number	Percentage
3-6	6	0
6.1-9	28	4 (14.3)
9.1-12	21	10 (47.6)
12.1-15	4	3 (75)

Table 7: Number of patients in Group L and Group U showing progression

Dirunal variation	Number of patients	Number of patients showing progression (%)
Lowest 25th percentile (Group L)	15	1 (6.67)
Highest 25th percentile (Group U)	15	8 (53)
Middle 50th percentile	29	8 (27.6)

Table 8: Correlation between baseline intraocular pressure and pattern defect change/year

Baseline office IOP range (mmHg)	PD change per year (dB)	
	Range	Mean
10-14	0.2-1.8	0.9
15-19	0.6-2.6	1.7
20-24	0.4-1.6	1.1

IOP – Intraocular pressure, PD – Pattern defect

Since now it is a well-known fact that IOP is not constant and fluctuates through the day (Circadian rhythm), it has been suggested often that the progressive damage in some cases could be because of peaks of IOP or a variability of diurnal IOP not detected by tonometry during office hours.[3-7] This has prompted a number of investigators to monitor the IOP more closely with inpatient diurnal tonometry or by home tonometry.[3,4,8-12] This closer monitoring has indeed revealed variability and in some cases, previously undetected peaks and fluctuations in IOP.[6]

Diurnal fluctuations in IOP can be classified into regular-associated with a biorhythm and irregular-associated with random pressure peaks.[6,13]

These may be further subdivided into four types:[6]

1. Morning type, in which the pressure peaks between 4 and 8 am and is lowest during the day or night
2. Day type, in which the IOP peaks during the day, usually before noon, but sometimes in the afternoon and the minimal pressure occurs during the night or evening
3. Night type, in which the maximal pressure is recorded between midnight and 4 am, and the minimum is recorded during the day
4. Flat type, in which the circadian variation is too small to characterize a periodicity or phase.

The reported mean amplitude of the normal daily fluctuation ranges from approximately 3–6 mmHg. An amplitude >10 mmHg is generally considered pathologic.[14] Drance reported a diurnal variation of 5.5 mmHg in normal persons, 7.5 mmHg in patients with open-angle glaucoma with apparently controlled IOP, and 12.5 mmHg in patients with OAG off-treatment. Although the risk associated with such findings has not yet been elucidated, many have considered the findings sufficient justification for altering therapy.[4,6,7,9,12,15-17]

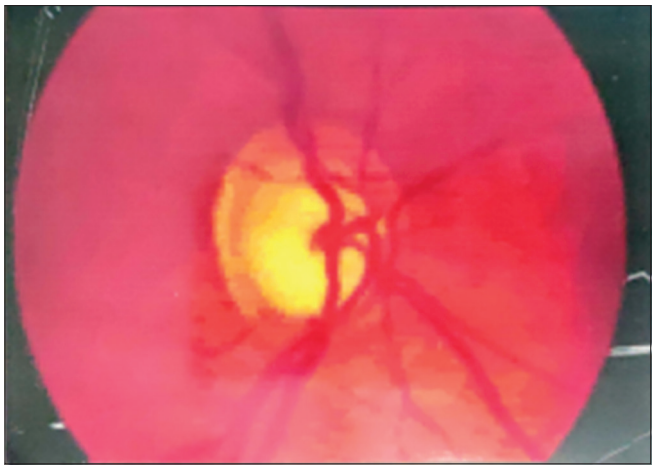


Figure 1: Optic disc with neuroretinal rim thinning

Table 9: Correlation between baseline diurnal fluctuation and pattern defect change per year

Baseline diurnal fluctuation (mmHg)	Number of patients	PD change per year (dB)	
		Range	Mean
3-6	6	0.2-1.4	0.6
6.1-9	28	0.5-1.8	0.9
9.1-12	21	0.8-1.8	1.4
12.1-15	4	1-2.6	1.8

PD – Pattern defect

Table 10: Patients showing significant change in diurnal fluctuation from baseline in Group-L and Group-U

Group	Total number of patients	Patients showing significant increase	Patients showing significant decrease
Group-L	15	1 (Group L+)	0 (Group L,)
Group-U	15	0 (Group U+)	3 (Group U,)

Table 11: Diurnal Fluctuations of intraocular pressure in patients with Glaucoma medications

Anti-glaucoma medications	Number of eyes (%)	Diurnal fluctuation range (mmHg)
Topical timolol 0.5%	14 (23.7)	3.2-13.6
Topical timolol + topical brimonidine	1 (1.7)	9.4
Topical latanoprost	8 (13.6)	3-7.7
Topical bimatoprost	2 (3.4)	4.5-7.4

Various protocols have been used to measure circadian variations. One way is to hospitalize the patient and do 1 hourly or 2 or 3 hourly measurements.[18,19] Advantages of this method include accurate round-the-clock measurements under constant medical supervision. Disadvantages include its cost and alteration of patient's normal daily activities. Other methods used to measure IOPs are on an outpatient basis during day and to hospitalize the patient at night,[20] taking the IOP readings in office hours from early morning till late afternoon, or self-tonometry performed by patients at home.[4,9,12,14,21]

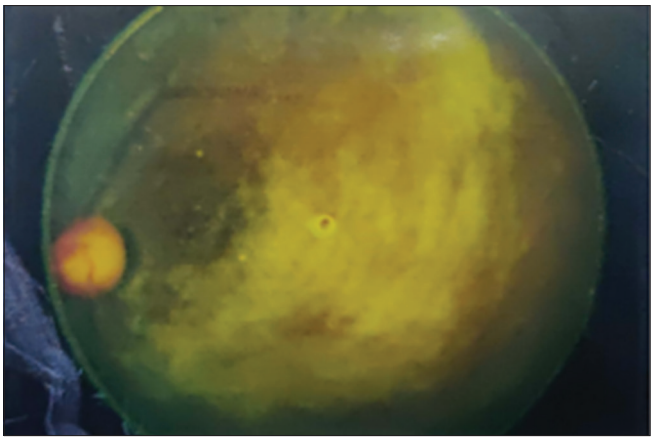


Figure 2: Superior and inferior arcuate RNFL defects

Aims and objectives

1. To establish a correlation between diurnal fluctuation in IOP and progression of chronic simple glaucoma
2. To determine whether diurnal IOP fluctuation is an independent risk factor for progression of chronic simple glaucoma.

MATERIALS AND METHODS

A prospective study was conducted on 72 patients attending the Department of Ophthalmology, F. H. Medical College from January 2018 to December 2019.

Sample size estimation and sampling method

The eyes of the patients were selected by simple random sampling using a table of random numbers.

Our study included a total of 72 eyes of 72 patients, selected from among the patients attending our outpatient department and glaucoma clinic. Only 1 eye of each patient was included in the study.

Out of the 72 eyes, 8 (11%) patients were lost to follow-up (<4 visual fields or <1-year follow-up) and 5 patients (6.9%) (all NTG group) were excluded from the study (due to IOP >25 mmHg at some time point during follow-up). Hence, our final analysis included 59 eyes of 59 patients (study population).

Inclusion criteria

All cases suspected or diagnosed as chronic simple glaucoma having characteristic visual field defects or optic disc change [Figures 1 and 2] or both and having office IOP <25 mmHg.

Exclusion criteria

1. All eyes with office IOP ≥25 mmHg at any time during the study period

2. Patients with angle-closure glaucoma, Juvenile glaucoma, pseudoexfoliation syndrome, pigment dispersal syndrome, or any other form of secondary glaucoma
3. Ocular hypertensives
4. All eyes exhibiting other pathological changes in addition to glaucoma, e.g. dense cataract precluding optic nerve head assessment or visual field testing, corneal opacity, hypertensive and diabetic retinopathies, macular degeneration
5. Patients who had undergone surgery for cataract or glaucoma during the study period.

The patients selected underwent detailed examination and were evaluated after taking the required demographic data and thorough history. The study was conducted in accordance with tenets of Declaration of Helsinki. Informed consent was obtained from each patient.

Intraocular pressure measurement

A baseline IOP was recorded with Goldman's applanation tonometer using a mean of three readings. Further office IOP reading was taken using the same technique at one monthly interval, every time taking a mean of 3 readings. If at any time the IOP of patients was found to be >24 mmHg, the patient was excluded from the study.

All patients underwent slit-lamp examination, gonioscopy, central corneal thickness measurement, and fundus examination. Two-dimensional colored photographs of central 20° fundus and retinal nerve fiber layer photographs using monochromatic (red free) filters covering 30° of the fundus were taken as required.

Visual field testing (using automated perimetry)

All the patients underwent static perimetry glaucoma-test, program 30-2, full threshold using automated perimeter (APPA GLAUFIELD LITE). Usually, there is a learning curve of 3–4 fields after which reliable test results are obtained.

To obtain reliable baseline fields, we obtained 3 visual fields at 1 week interval, and if the 3rd field was reliable (all the reliability indices within appropriate range, i.e. FP <20%, FN <33%, fixation, loss <20%), it was taken as the baseline field; otherwise, the patient was called after 1 month again to get the baseline field. If still unreliable, the patient was excluded from the study. After obtaining a baseline visual field, the patient was called for follow-up at 3 monthly interval.

Measurement of diurnal fluctuation in intraocular pressure

For this, the patients were admitted in the hospital for 1 day (from 7 AM to 10 PM), and IOP readings were taken 2 hourly from 8 AM to 10 PM using a Schiotz tonometer.

The antiglaucoma drugs being used or started were also noted. The patients were asked to continue as much of their normal daily activities as possible.

Three such diurnal curves with 3 readings of diurnal fluctuation were taken at 1 week interval. The mean of these 3 readings was taken as the baseline diurnal fluctuation. Successive diurnal curves and fluctuation were obtained at 6 monthly interval thereafter, using the same technique, but taking only one reading instead of three.

The IOP readings were taken by a single examiner who was unaware of the patient's glaucoma status to avoid an examiner-induced bias.

Calculation of corrected intraocular pressure

A correction of 1 mmHg was applied per 20 μm change in corneal thickness from 525 μm.

Estimation of visual field progression

At least 4 reliable visual fields were required to make a reliable estimate of progression, whether present or absent, and if present, how much? The minimum required follow-up was kept as 1 year.

To define whether there was progression or not, the criteria given by Hodapp *et al*.[22] also suggested by the European Glaucoma society[23] were considered.

To correlate the range of diurnal fluctuation with the extent of visual field progression, we used the regression analysis based on pattern defect which is provided by the Field Explorer software.

Grouping of patients

For determining whether IOP fluctuations acted as an independent risk factor for glaucoma progression, the patients were divided into 2 groups according to their baseline diurnal fluctuation:

- Group "L": Consisted of patients having their diurnal fluctuation in the lower 25th percentile
- Group "U": Consisted of patients whose diurnal fluctuation lied in the upper 25th percentile.

If during the follow-up period, the diurnal fluctuation of patients changed by ≥2 standard deviation (SD) of their baseline diurnal fluctuation, they were further subgrouped as follows:

Patients in the lower 25th percentile whose diurnal fluctuation

- Decreased by >2 SD from baseline – L (−)
- Increased by >2 SD from baseline – L (+)

Patients in the upper 25th percentile whose diurnal fluctuation

- Decreased by >2 SD from baseline – U (−)
- Increased by >2 SD from baseline – U (+)

RESULTS

Demographic profile

Out of the 59 patients included in the final study, 46 (77.9%) patients were male and 13 (22.1%) were female. Their age ranged from 39 to 84 years with a mean age of 60.8 years.

Baseline intraocular pressure

The baseline uncorrected office IOP of our patients ranged from 10 mmHg to 24 mmHg (mean: 18 mmHg). The central corneal thickness of our patients ranged from 454 to 546 μm (mean: 498 μm). After applying the correction of ± 1 mmHg per 20 μm decrease or increase in corneal thickness from 525 μm, the corrected baseline office IOP was found to range from 11 mmHg to 23 mmHg (mean: 17.8 mmHg). More than half of patients (57.66%) had their corrected IOP in the range of 15–19 mmHg.

Optic nerve head changes

The optic nerve head changes varied from polar notching and a localized NRR thinning to advanced glaucomatous optic neuropathy with 0.8 cup, with maximum number of patients (45.8%) having cup: disc ratio in the 0.5–0.6 range [Table 1].

Visual field changes

The baseline visual field defects ranged from no defect to advanced visual field loss with central and temporal field remaining. The average defect ranged from − 11.19 to − 23.42 dB (mean: −17.42). The pattern defect ranged from 3.24 to 12.88 dB (mean: 8.51).

Intraocular pressure fluctuation

The peak IOP ranged from 14.6 mmHg to 28.4 mmHg (mean: 23.8 mmHg), with the lowest peak IOP being seen in the 10–14 mmHg IOP group and the highest peak IOP being seen in the 15–19 mmHg IOP group. The mean peak was 22.4 mmHg in the patients having baseline IOP in the range of 10–14 mmHg, 24.7 in the patients with baseline IOP 15–19 mmHg, and 22.8 in the patients having baseline IOP 20–24 mmHg. Thus, the highest mean peak IOP was seen in the patients with baseline IOP in the range of 15–19 mmHg.

The trough IOP ranged from 9.4 to 18.9 mmHg (mean: 13.9 mmHg), with the lowest value being seen in the 10–14 mmHg group and the highest value being seen in the 20–24 mmHg group. The mean trough IOP was 13.2 mmHg in the patients having their baseline IOP in the range of 10–14 mmHg, 14.2 mmHg in the patients with baseline IOP 15–18 mmHg, and 15.4 in the patients with baseline IOP 20–24 mmHg.

The baseline diurnal fluctuation of our patients varied from 3 mmHg 13.6 mmHg (mean: 8.5 mmHg). The mean diurnal fluctuation in the patients having their baseline IOP in the range of 10–14 mmHg was 8.0 mmHg. In the patients with baseline IOP 15–19 mmHg, it was 8.7 mmHg, and in the patients having their baseline IOP in the range of 20–24 mmHg, the mean fluctuation was 8.4 mmHg. Thus, the highest mean fluctuation was seen in the group of patients having their baseline office IOP in the range of 15–19 mmHg.

Timing of peak intraocular pressure

The timing of peak IOP varied, but in the majority of cases, the IOP peaked in morning hours.

Antiglaucoma medications

The antiglaucoma medication on which the patients were at the baseline evaluation was also noted.

Progression

Out of the 59 patients, 17 (28.8%) patients progressed.

When the diurnal fluctuations of the patients were divided into percentage, it was found that 1 (6.67%) patient in the lower 25th percentile progressed, while 8 patients (53%) in the upper percentile progressed.

Using Chi-square test, the different in progression between the two groups was found to be statistically significant ($P < 0.01$).

The rate of progression of visual field expressed in terms of pattern defect change per year ranged from 0.2 dB to 2.6 dB.

The coefficient of correlation (*r*) between the baseline office IOP and PD change/year was found to be 0.1. Thus, there was a week correlation between these two.

The coefficient of correlation (r) between the baseline diurnal fluctuation and the pattern defect change/year was found to be 0.9.

Thus, there was a strong correlation present between the baseline diurnal fluctuation and the amount of pattern defect change/year.

Of the 15 patients in the lower 25th percentile of diurnal variation (Group L), 1 patient showed a significant increase (L +) in diurnal variation (+2 SD) from baseline.

Of the 15 patients in Group U, no patient showed a significant increase in diurnal fluctuation from baseline (Group U+), while 3 patients showed a significant decrease (−2 SD) in diurnal fluctuation from baseline (Group U−).

The Gp L(+) patient who showed a significant increase in diurnal fluctuation also showed progression of visual field.

The group U (−) patients who showed a significant decrease in diurnal fluctuation did not show a progression of visual field.

DISCUSSION

The realization that IOP varies during the day has led a number of investigators to monitor the pressure over the day in order to study the relationship with the concurrent glaucomatous damage.[2] The results varied and were inconclusive because the majority of studies were cross-sectional studies which did not exclude the effect of elevated IOP itself. Thus, the glaucomatous damage observed was more likely to be related to the past intraocular pressure characteristics than those at the time of monitoring. Other studies which were done longitudinally either used a self-tonometer, the reliability of which is questionable, or included few IOP readings only (morning to evening or morning to afternoon).[3,6,10,24,25]

Thus, this study was undertaken to determine whether increased diurnal fluctuation in intraocular pressure is an independent risk factor for glaucoma progression as determined by a progression in visual field defect and to determine the amount of correlation between the diurnal IOP fluctuation and progression of glaucoma.

This study was conducted over 72 eyes of 72 patients, of which 13 (17.9%) were excluded from the study either due to inadequate follow-up or significantly increased IOP during the follow-up. Because it is well accepted and documented that elevated intraocular pressure is associated with a higher risk of progression, we concentrated on patients without markedly elevated IOP throughout the years of follow-up. This strict criterion of stable office IOP led to the exclusion of only 6.9% of the original group of eyes of patients with glaucoma. Most of the excluded eyes (61%) were because of a lack of follow-up. Thus, the final analysis included 59 eyes of 59 patients.

Despite major advances in optic nerve head and retinal nerve fiber layer evaluation techniques, the evaluation of visual field series remains the clinical method most frequently used to assess the course of glaucoma and the efficacy of treatment.[26] Thus, we used a series of at least four visual fields, obtained after the learning curve of the patient, over a period of 2-year follow-up, to determine whether glaucoma is progressing or not. Since the follow-up of our study was relatively short, we used a method of determining visual field progression that was based on pointwise analysis of visual fields, so that progression could be detected early.

The average age of patients in our study was seen to be 60.8 years. The central corneal thickness of our patients ranged from 454 to 546 μm with an average of 498 μm. Thus, the central corneal thickness of our patients was slightly lesser than the general population. The baseline corrected intraocular pressure of our patients ranged from 11 mmHg– 23 mmHg, with the maximum number of patients (57.6%) in the 15–19 mmHg group. The mean baseline corrected office IOP was found to be 17.6 mmHg, with the mean peak IOP was found to be 23.8 mmHg; thus, the peak IOP on an average was 6.2 mmHg higher than the office IOP. This is in concordance with an earlier study done by Hughes *et al*. who reported the mean peak IOP during 24 h monitoring to be 4.9 mmHg higher than the mean office IOP.[27]

As per Table 2, the pattern defect at baseline was found to range from 3.24 to 12.88 dB, and it was observed that the highest mean pattern defect was seen in patients having their baseline IOP in the range of 10–14 mmHg. This could be because of the fact that these patients with higher pattern defect values at baseline were having more advanced glaucoma and thus were undergoing more aggressive antiglaucoma treatment.

The Table 3 shows, the mean baseline diurnal fluctuation of our patients was 8.5 mmHg, with values reaching as high as 13.6 mmHg in some patients. It is well known that glaucoma patients exhibit large ranges in IOP, but this magnitude is somewhat surprising in the present group of patients who had office IOPs around 18 mmHg and always below 25 mmHg.

The majority of the diurnal curves peaked in morning hours (8 am–12 noon) and reached trough at night (8 pm–10 pm) [Tables 4 and 5]. This pattern is similar to that reported by various other earlier studies including that done by David *et al*.[16,17,24,28-31]

28.8% of the patients of our study group showed progression at the end of 2-year follow-up. This is somewhat higher than the rate reported by other studies like glaucoma laser trial follow-up study which reported 27% progression at 42 weeks. A possible reason for the difference could be that

the glaucoma laser trial included newly diagnosed glaucoma cases having only mild visual field defects, while our study included visual field defects ranging from mild to severe.[31]

As the baseline diurnal fluctuation increased, the number of patients showing progression increased, with 75% of patients in the diurnal fluctuation range of 12–15 showing progression. 53% of patients in the upper 25th percentile of diurnal fluctuation progressed, while only 1% of the lower 25th percentile progressed ($P < 0.01$) [Tables 6 and 7].

The two groups of patients were similar in terms of age and sex distribution and baseline visual field defects, but the baseline office IOP was higher in the upper 25th percentile group although the difference was not statistically significant ($P > 0.05$).

Thus, increased diurnal fluctuation acted as a significant risk factor for glaucoma progression, irrespective of baseline office IOP. This is in accordance with the study conducted by Asrani *et al*. who reported that increased diurnal fluctuation acts as an independent risk factor for glaucoma progression.[32]

When the rate of progression in terms of pattern defect change/year was correlated with baseline office IOP and baseline diurnal fluctuation, it was found that the progression was weakly correlated with baseline office IOP ($r = 0.1$), while it was strongly correlated with baseline diurnal fluctuation ($r = 0.9$). Thus, there is a strong correlation between the diurnal fluctuation in IOP and progression of chronic simple glaucoma [Tables 8 and 9].

We also performed diurnal fluctuation measurement at 3 monthly intervals to detect any significant change from baseline diurnal fluctuation, and it was observed that 12 (20.3%) patients showed a significant change (±2 SD) in diurnal fluctuation from the baseline. Of these 12 patients, 3 patients showed a significance increase and 9 patients showed a significant decrease in diurnal fluctuation. All the 3 patients showing significantly increased diurnal fluctuation progressed [Table 10]. The changes in diurnal fluctuation could be attributed to change in medications, varying compliance of the patients, and the tendency of glaucomatous patients to show a highly variable IOPs. Of the 7 patients in the upper 25th percentile of diurnal fluctuation who did show progression, 3 patients had a significant decrease in diurnal fluctuation during the follow-up. This could have diluted our results, and correcting for this change in diurnal fluctuation could have given an even stronger correlation.

A large majority (49%) in our patients were on topical timolol therapy at initiation of study. These patients showed an average diurnal fluctuation of 8.4 mmHg (range, 3.2–13.6 mmHg) [Table 11]. On the other hand, patients on prostaglandin group of drugs showed a lesser diurnal fluctuation (average, 5.9 and range, 3–7.7 mmHg) and baseline office IOP. Thus, these drugs seem to provide a better control of both office IOP and diurnal IOP fluctuation. This finding is in accordance with other randomized control trial which concluded that latanoprost seemed to induce a uniform reduction in IOP during the 24-h period, although timolol was as effective as latanoprost during the daytime and dorzolamide are as effective as latanoprost at night.[33]

We had to hospitalize the patients to record the diurnal IOP measurements. This could have altered their normal diurnal fluctuation, although a large majority of patients were in the older age group and already having a sedentary lifestyle and thus had no major changes in their routine.

Thus, our study reveals that large fluctuation in IOP during the day is not only associated with an enhanced risk but, more importantly, have an effect over and above those of other known strong risk factors for glaucoma progression. There is a strong correlation between the diurnal fluctuation and the progression of glaucoma. These findings have implications for the clinical management of patients with glaucoma. Fluctuation in IOP is a risk factor that can only be measured outside the clinic, and only monitoring of IOP over a number of days can assess the fluctuation reliably, because of change in IOP from day to day. This study provides evidence to substantiate the recommendation made in the past by experts to measure diurnal fluctuation in patients whose IOP seems to be well controlled in the office. Moreover, the study indicates that because the fluctuation *per se* is associated with the risk of progression, it may need to be treated specifically. This poses a new challenge in therapy. It is possible that certain drugs or surgical interventions are more effective than others at dampening the fluctuations. Well-controlled studies with a longer follow-up are needed to corroborate our findings and to further address these issues, and it is hoped that if our findings are further substantiated in larger studies, new treatment modalities will be developed specifically to reduce intraocular pressure fluctuation.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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Original Article

A clinical study of childhood penetrating ocular trauma in a tertiary care center in Southern India

ABSTRACT

Aims: Ocular trauma is one of the major causes of monocular blindness in the pediatric age group, causing significant visual morbidity. The purpose of this study is to identify the causes, types, location of injuries, and clinical features due to ocular trauma in a tertiary care center. **Settings and Design:** It is a retrospective hospital-based observational study. **Materials and Methods:** Demographic details of 69 consecutive patients up to 14 years of age who were hospitalized for primary repair of penetrating ocular injuries during March 2017 to March 2019 were documented and evaluated. **Results:** Fifty-six (81.16%) children were male. The mean age was 8.31 ± 3.96 years. Thirty-one (44.93%) were in the 6–10-yearage group. The most common cause of injury was with wooden stick in 23 cases (33.33%). Full-thickness corneal tear was seen in 52 cases (75.36%). Associated anterior segment involvement included iris prolapse in 34 cases (49.28%), hyphemia in 11 (15.94%), and traumatic cataract in 15 (21.74%), interlamellar corneal foreign body in two cases, and associated full-thickness lid tear involving lid margin in two cases. The posterior segment involvement in the form of vitreous hemorrhage in 19 (27.53%) cases, retinal detachment involving macula in seven cases (10.14%), choroidal detachment in six cases (8.69%), endophthalmitis in five cases (7.25%), and retained intraocular foreign body in three (4.35%). **Conclusions:** Prevention is always considered superior to the best treatment. Parents should be educated about the devastating complications of ocular trauma, need for supervision, and need for timely referral to the eye care center.

Keywords: Corneal tear, pediatric eye trauma, penetrating ocular trauma

INTRODUCTION

Ocular trauma is one of the major causes of unilateral preventable blindness in the pediatric age group and accounts for approximately 8%–14% of total injuries.[1-3]

It is a devastating injury, leading to significant ocular morbidity, social, and economic burden to both the family and society and occurs from unsupervised activities.[4] The study is conducted in a referral hospital where patients are referred from peripheral centers owing to the lack of surgical setup or anesthetic care. Children are vulnerable to ocular trauma, and this study series was done to examine the demographic variables and determine the pattern, type, and mode of injury and associated visual morbidity in these pediatric age group. This study will help in estimating the burden of the childhood preventable blindness in this region, to identify the contributing factors responsible and hence taken necessary preventive measure and educate parents about the same.

MATERIALS AND METHODS

It is a retrospective hospital-based interventional clinical study of ocular trauma in pediatric age group over 2-year duration from March 2017 to March 2019. All children from 0

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to 14 years of age with a history of penetrating ocular trauma were hospitalized. In cases associated with neurological or other systemic injuries, patients were referred to a specialist and treated accordingly before admission for further ocular management. Patient's demographic details such as name, age, sex, date and time of injury, time lapse between injury and hospital presentation, causes of injury, and visual symptoms were documented. Visual acuity was taken in Snellen's chart in older and cooperative children. Slit-lamp aided anterior segment examination was carried out to know the extent of injury. In children <4 years, a cursory table examination was done before surgery to assess the extent of injury. Radiological examination was done in all cases to rule out the fractures of orbit or retained intraocular foreign bodies. Injection tetanus toxoid was given in previously nonimmunized and older children. Intravenous cefotaxime and amikacin adjusted to the body weight were administered. All patients underwent primary repair under general anesthesia. Some required additional surgical procedures such as vitrectomy and cataract surgery at a later date. Data were collected and analyzed using a suitable statistical method.

RESULTS

The mean age of children presenting to us with penetrating ocular trauma was 8.31 ± 3.96 years. Seventeen (24.64%) children were aged 5 years or less, 31 (44.93%) were in the 6–10-year age group, and 21 (30.43%) were between 11 and 14 years. The youngest child in our study was 2 years and the oldest was 14 years. Fifty-six (81.16%) children were male. Left eye (43 cases) was more commonly involved. No cases with bilateral involvement were reported.

The most common cause of injury was through wood stick and vegetative matter (plant stems, thorn, and broomstick) which accounted for 23 (33.33%) cases.

Other modes of injury included metallic objects (scissors, wires, iron rod, and hammer), stones, and glass pieces (bangles) which tend to cause penetrating injuries. A single case each of injury due to road traffic accident, firecracker injury, and animal injury (goat horn) was noted [Table 1].

The mean time interval between injury and presentation to the hospital was 27.94 h. Twenty-two (31.88%) cases presented within 6 h of presentation, 27 (39.13%) cases presented within 24 h, 8 (11.59%) between 24 h and 48 h, whereas 12 (17.39%) cases presented after 2 days of sustaining injury.

The most common type of injury was full-thickness corneal tear, seen in 52 cases (75.36%), followed by combined full-thickness corneoscleral tear seen in eight cases (11.59%). Scleral tear alone was seen in three cases (4.35%), and six cases presented with self-sealed corneal tear (8.7%). In all age groups, the most common type of injury was a full-thickness corneal tear [Table 2 and Chart 1].

Anterior segment involvement included iris prolapse in 34 cases (49.28%), hyphemia in 11 (15.94%), traumatic cataract in 15 (21.74%), intralamellar corneal foreign body in two

Table 1: Modes of injury in various age groups

Mode of injury	Age group (years) (%)			Total (%)
	0-5	6-10	>10	
Wood	5 (29.41)	9 (29.03)	9 (42.86)	23 (33.33)
Metal	5 (29.41)	5 (16.13)	3 (14.29)	13 (18.84)
Stone	2 (11.76)	8 (25.81)	4 (19.05)	14 (20.29)
Pen	1 (5.88)	5 (16.13)	0	6 (8.7)
Glass	1 (5.88)	1 (3.23)	1 (4.76)	3 (4.35)
Knife	1 (5.88)	1 (3.23)	1 (4.76)	3 (4.35)
Bat and ball	1 (5.88)	0	0	1 (1.45)
Bijli cracker	0	1 (3.23)	0	1 (1.45)
Finger nail	1 (5.88)	0	0	1 (1.45)
Goat's horn	0	1 (3.23)	0	1 (1.45)
Plastic spring	0	0	1 (4.76)	1 (1.45)
Rope	0	0	1 (4.76)	1 (1.45)
Road traffic accident	0	0	1 (4.76)	1 (1.45)
Total	17	31	21	69

Table 2: Type of injury with associated anterior segment findings

Type of injury with anterior segment finding	Number of cases
Full thickness corneal tear	10
Full thickness corneal tear with hyphemia	4
Full thickness corneal tear with iris prolapses	19
Full thickness corneal tear with iris prolapses with hyphemia	3
Full thickness corneal tear with iris prolapses with traumatic cataract	5
Full thickness corneal tear with iris prolapses with traumatic cataract with lens subluxation	2
Full thickness corneal tear with traumatic cataract	7
Full thickness corneal tear with interlamellar corneal foreign body	2
Full thickness corneoscleral tear with iris prolapse with hyphemia	3
Full thickness corneoscleral tear	3
Full thickness corneoscleral tear with iris prolapse	1
Full thickness corneoscleral tear with full thickness lid tear	1
Full thickness scleral tear	1
Full thickness scleral tear with iris prolapses with hyphemia	1
Full thickness scleral tear with full thickness lid tear	1
Self sealed corneal tear	5
Self sealed corneal tear with traumatic cataract	1

cases, and associated full-thickness lid tear involving lid margin in two cases [Chart 2].

Posterior segment involvement was seen in the form of vitreous hemorrhage in 19 (27.53%) cases, retinal detachment involving macula in seven cases (10.14%), choroidal detachment in six cases (8.69%), endophthalmitis in five cases (7.25%), retained intraocular foreign body (IOFB) in three (4.35%), posterior vitreous detachment in two cases (2.89%), and subhyaloid hemorrhage in one case (1.44%) [Table 3 and Chart 3].

All children underwent primary tear repair under general anesthesia. B-scan and X-ray orbit was done in all cases after primary tear repair. Additional surgeries were done in 15 children that is vitrectomy. Three children required IOFB removal based on B-scan and imaging findings. No intraoperative anesthesia-related complications were seen.

Vision using Snellen's chart could be assessed in 54 children. Sixteen (23%) children had vision at the presentation at perception of light (PL) positive, 14 (20%) had hand movement (HM) positive, 10 (14.49%) had less than 6/60 at initial presentation, 11 (15.9%) had than 6/60, two had 6/36, and one had 6/24. However, in most cases, vision could not be assessed accurately as child was uncooperative due to anxiety and pain. In preverbal children, vision could not be assessed.

Vision at the end of 5 days (average duration of stay) was 19 (27.5%) children had HM positive, 17 (24.6%) with PL positive, 14 (20.2%) had vision of 6/60, one had 6/36, and five (7%) had vision of worse than 6/60 [Chart 4].

DISCUSSION

In this study, 69 patients in the pediatric age group (until the age of 14 years) with ocular injuries were studied during March 2017 to March 2019.

In our study, the mean age group affected was 8.31 ± 3.96 years, and the maximum incidence of ocular injury was between 6 and 10 years (44.93%). This correlates with the works of Singh *et al*.[1] and Misra Neeta *et al*.[5] who found that the maximum incidence of ocular injuries was found to be 47.27% and 48% in 6–10-year age group, respectively. A Gupta *et al*. found the mean age to be 9.8 years.[6] Studies by A. Kaur[3] showed similar results. Studies by Qayum found the majority between 2 and 6 years.[2]

The incidence was higher in males that is 56 cases (81.16%). This can be explained, on the basis, that boys, spend more time playing outside, are more adventurous as compared to females.[1-8]

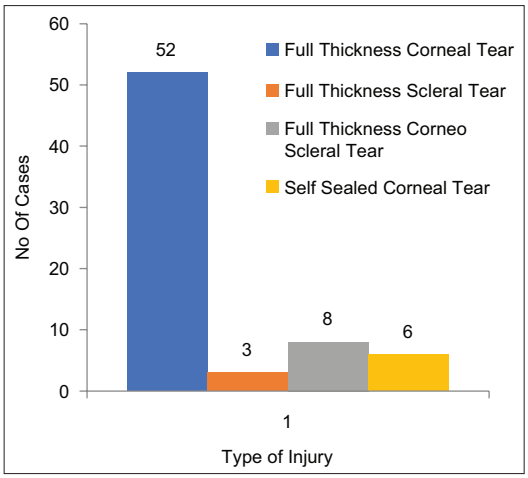


Chart 1: Type of injury

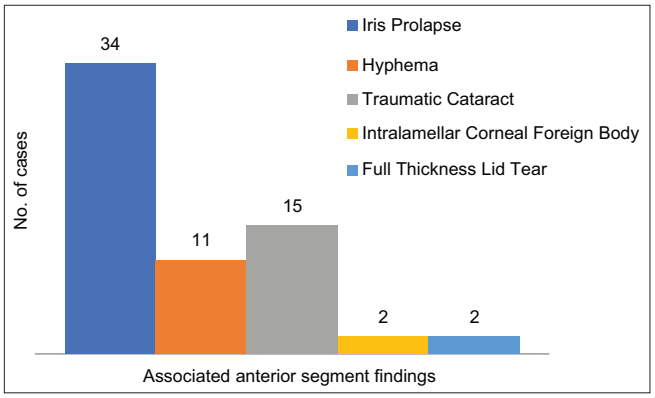


Chart 2: Anterior segment findings

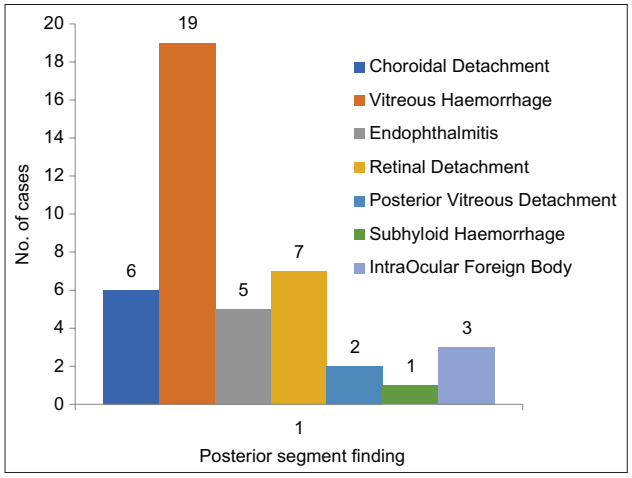
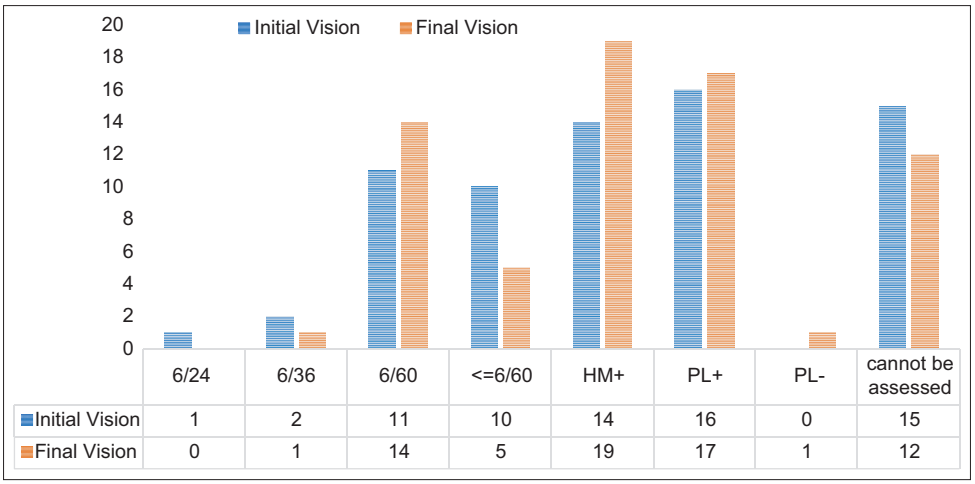


Chart 3: Posterior segment finding

The most common mode was wooden stick 23 (33.33%) in our scenario as wooden objects are readily available.[1,6] Other modes of injury included metallic objects (scissors, wires,



	6/24	6/36	6/60	<=6/60	HM+	PL+	PL-	cannot be assessed
Initial Vision	1	2	11	10	14	16	0	15
Final Vision	0	1	14	5	19	17	1	12

Chart 4: Vision at admission and at discharge

Table 3: Posterior segment finding

Posterior segment findings	Number of cases
Within normal limits	39
Choroidal detachment	1
Choroidal detachment with vitreous hemorrhage	2
Endophthalmitis	4
Endophthalmitis with retinal detachment	1
Intraocular foreign body	3
Posterior vitreous detachment	1
Posterior vitreous detachment with vitreous hemorrhage with sub hyaloid hemorrhage	1
Retinal detachment with choroidal detachment	1
Retinal detachment with choroidal detachment with vitreous hemorrhage	2
Retinal detachment with vitreous hemorrhage	3
Vitreous hemorrhage	11

iron rod, and hammer), stones, vegetative matter, and glass pieces (bangles). A single case each of road traffic accident, firecracker injury, and animal (horn) injury was observed.

Twenty-two cases (31.88%) presented to the hospital within 6 h, 27 cases (39.13%) within 24 h, eight cases (11.38%) between 24 h and 48 h, and 12 cases (17.88%) after 48 h. The most common cause for delayed presentation included lack of health services within reachable distances. Other factors included illiteracy and lack of awareness on the part of parents.[6] Singh *et al*.[1] reported that final visual acuity was significantly poor in eyes where the primary repair was delayed beyond 24 h. Delayed repair is associated with poor visual outcome.[8] This is due to more inflammation and secondary infections.[6]

The majority of cases out of the 69 presented with corneal tears more than 5mm (60%), and in 38 (55.07%) cases, pupillary axis was involved. The incidence of complications such as prolapse of intraocular contents, injury to vital structures, increased risk of the secondary infection, and increased postoperative astigmatism is more with larger lacerations. Tears in the pupillary area involving the visual axis have a poorer prognosis when compared to peripherally placed tears.[1]

Anterior segment involvement included iris prolapse in 34 cases (49.28%), hyphemia in 11 (15.94%), traumatic cataract in 15 (21.74%), intralamellar corneal foreign body in two cases, and associated full-thickness lid tear involving lid margin in two cases. Posterior segment involvement was seen in the form of vitreous hemorrhage in 19 (27.53%) cases, retinal detachment involving macula in seven cases (10.14%), choroidal detachment in six cases (8.69%), endophthalmitis in five cases (7.25%), retained IOFB in three (4.35%), posterior vitreous detachment in two cases (2.89%), and subhyaloid hemorrhage in one case (1.44%). Children with posterior segment complications such as endophthalmitis and retained intraocular foreign bodies had to be taken up for additional surgeries.

According to Gupta *et al*., patients who had simple surgical repair had better visual outcomes than those with complex repairs.[5]

Anterior segment involvement in the form of hyphemia, uveal tissue detachment, choroidal hemorrhage/detachment, vitreous loss, and retained IOFB achieved final visual acuity were associated with poor visual prognosis. Posterior segment injuries are more visually devastating than anterior segment injury or ocular adnexal injury. Various studies reported poor visual outcome in cases with posterior segment involvement.[4,9,10]

The major limitations in our study included inability to accurately assess vision due to the young age of the patients, only penetrating injury was considered, blunt trauma was not included in our study, so generalization of ocular trauma in children is not possible, many self-sealed tears which did not require hospitalization was not included in the study. Postoperative visual acuity could be assessed in all cases till discharge from the hospital. However, immediate postoperative visual acuity assessment is not reliable due to the increased incidence of uveitis, astigmatism in children.

Furthermore, the evaluation in pediatric cases is often difficult and unreliable due to variable history given and poor patient cooperation during examination.[5]

Attempts to reduce blindness in children due to trauma include increased awareness, encouraging public to seek early treatment and training ophthalmologist in peripheral health centers in skills necessary to effectively manage ocular trauma.[11]

CONCLUSIONS

Children are vulnerable to ocular trauma and need more supervision. Prevention is always superior to the most effective treatment. The injuries could be prevented with foresight, good supervision from parents and teachers, and increasing public awareness. Children in rural areas tend to play with wooden sticks and stones which is the most common cause of ocular injury. The concept of child-proofing of houses and keeping sharp objects such as needles, pens, pencils, and knives out of reach of children must be promoted. The use of helmets and goggles to reduce ocular trauma in road traffic accidents. In the event of the mishap, the need for immediate medical attention should be emphasized.

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Outcome of porous polyethylene implants in anophthalmic sockets with implant migration

ABSTRACT

Purpose: To evaluate the surgical outcome of porous polyethylene orbital implants in anophthalmic sockets with implant migration. **Methods:** A prospective interventional case series: Patients of anophthalmic sockets with implant migration were recruited, which were replaced with porous polyethylene implants. Patients were evaluated for recurrence of implant migration, ability to wear artificial eye, movement of prosthesis, complications, and satisfaction. **Results:** Fifteen patients with a mean age of 8.33 years were operated for implant migration. Postoperatively, recurrence of implant migration was seen in one patient. Fourteen patients were able to wear the artificial eye. The overall mean prosthetic motility at 6 months of follow-up was 26% of the contralateral eye. Enophthalmos (>2 mm) and pseudoptosis (>2 mm) were present in 2 patients each. Satisfaction was good in 10 patients and fair in 5 patients. **Conclusion:** The recurrence of implant migration was almost nil with the use of porous polyethylene orbital implant in a follow-up of 6 months. A majority (93%) of the patients could wear the artificial eye with good satisfaction.

Keywords: Anophthalmic socket, implant migration, Mules implant, porous polyethylene implant, silicone implant

INTRODUCTION

An orbital implant is placed in the orbit following enucleation or an evisceration procedure mainly to prevent postenucleation socket syndrome and for better cosmesis. Multiple types of orbital implants are available, each with its own advantages and disadvantages. The widely used implants are porous implants such as hydroxyapatite, porous polyethylene, and aluminum oxide implants.[1-5] The high cost of these implants is a major limitation, especially in developing countries. The commonly used non-porous spherical implants are polymethylmethacrylate (Mules) and silicone. They are cheaper and hence preferred in patients with low socioeconomic status. Limited literature is available on the complications with the use of these as primary implants. Implant migration is one of the common complications seen in 10–15% of patients, and more so with Mules spherical implants, probably because muscles can be sutured with silicone implants.[6] To minimize the problem of implant migration, the use of biointegrated porous implants during primary procedures has nowadays become more popular in the Western world. The rough surface of porous implants and fibrovascular ingrowth have significantly reduced the risk of implant migration.[7-9]

There is scanty literature on the surgical management of migration of non-porous implants used as primary implants during the enucleation procedure. To the best of our knowledge, a prospective interventional study on the management of implant migration is not available in the literature. This study was performed to evaluate the outcome of replacement of non-porous migrated implants with porous polyethylene implants in anophthalmic sockets.

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METHODS

This was a prospective interventional study conducted over a period of 18 months (March 2018 to August 2019) after obtaining ethical clearance from the Institute Ethical Committee. Patients of anophthalmic sockets with migration of non-porous orbital implants were included in the study after obtaining their informed and voluntary consent. Patients with severely contracted sockets, irradiated sockets, and/or periorbital deformity due to trauma were excluded. Informed written consent was obtained.

Detailed workup was done. Preoperative examination was done to look for facial asymmetry, entropion, ectropion, palpebral aperture width, presence of deep sulcus, forniceal depth, conjunctival surface, and volume of the socket. The volume of the socket was measured in the supine position by instilling saline, drop by drop, from a 5 cc syringe into an anesthetized dry socket. The volume of the socket was measured by noting the reading on the syringe when the first drop overflowed. The site and severity of implant migration were assessed. The severity of vertical migration was graded as follows: grade 1—the edge of the migrated implant had not reached the mid-canthal line (imaginary line between the lateral canthus and medial canthus of an anophthalmic socket), grade 2—edge of the migrated implant had crossed the mid-canthal line. Similarly, horizontal migration was graded with respect to the line drawn between the mid-point of the upper and lower eyelids.

The surgery was performed under local or general anesthesia depending on the age and cooperation of the patient. The surgical area was cleaned and draped. A horizontal conjunctival incision was placed in the center of the socket. The migrated implant along with its pseudocapsule was removed. A small piece (4 × 4 mm) of surrounding fat was also taken out. The pseudocapsule and the piece of fat were sent for histopathology. The size and type of the removed implant were assessed. The fossa created by the migrated implant was closed by mobilizing the surrounding fat and suturing it with 6-0 polyglactin 910 sutures. An Indian-made porous polyethylene implant was placed in a new cavity created in the center of the socket. Fornix formation sutures were put. A conformer was placed, and temporary tarsorrhaphy using a 4-0 silk suture was performed. A sufficient gap was left between the eyelids to examine the socket as far as possible. Postoperatively, topical antibiotics and lubricants were given. Fornix formation sutures were removed at 2 weeks of follow-up.

Intra-operatively, the type and size of the implant removed, presence of a fibrous capsule around the implant, presence of bony fossa at the site of migration, and the number of extra-ocular muscles identified and sutured were noted. Postoperatively, each patient was followed up on day 1, at 1 week, 2 weeks, 1 month, 2 months, 3 months, and 6 months. At each follow-up, the patient was examined for the amount of swelling, infection, pain, hematoma, or any other complaints. At 2 weeks of follow-up, fornix formation sutures were removed. At 4 weeks of follow-up, tarsorrhaphy was removed. At 2 months of follow-up, an artificial eye was advised. At each follow-up, prosthesis motility was assessed using the limbus test of Kestenbaum.

The primary outcome assessed was the recurrence of implant migration. The secondary outcomes assessed were the ability to wear an artificial eye, prosthesis movement, complications, and satisfaction. At the end of the study, collected data was statistically analyzed.

RESULTS

Fifteen patients with anophthalmic sockets with implant migration were enrolled. The mean ± standard deviation (SD) age of the patients was 8.33 years ± 4.62 (range: 2 to 19 years). The majority of the patients were male (12 patients). The left eye was enucleated in 11 patients and the right eye in 4 patients. In 10 patients, there was a history of surgery for implant repositioning for implant migration. The median duration of first migration in all of the patients was 30 months (1 month–17 years). The median duration of second migration in 10 patients was 6 months (1–60 months). The median duration of prosthesis use was 34 months (4 months–17.6 years). Indication of primary enucleation was retinoblastoma in all cases.

Pre-operatively, the implant was migrated inferiorly in 14 patients and superiorly in 1 patient. The severity of migration was grade 2 in all patients. Upper eyelid entropion was present in all patients, and lower lid ectropion was present in fourteen patients with an inferiorly migrated implant. Fullness of the upper eyelid was present in one case with a superiorly migrated implant. The horizontal palpebral aperture was statistically comparable with the normal eye. Deep superior sulcus was present in all patients with inferiorly migrated implants. The conjunctiva was pink, wet, and non-keratinized in all patients. Shelving of the inferior fornix was present in all fourteen cases with an inferiorly migrated implant. The mean ± SD inferior fornix depth was 0.11 ± 0.29 mm (range: 0–1 mm), and the superior fornix depth was 14.92 ± 1.03 mm (range: 14–17 mm) in fourteen patients with inferiorly migrated implants. The mean ± SD depth of the inferior fornix was 9 mm, and

superior fornix shelving was present in one patient with a superiorly migrated implant. The mean ± SD depth of medial and lateral fornix was 1.23 ± 0.43 mm (range: 1–2 mm) and 1.23 ± 0.43 mm (range: 1–2 mm), respectively. The mean ± SD volume of the socket was 2.26 ml ± 0.99 (range: 0.5–3 ml).

Intra-operatively, a pseudocapsule around the implant was found in 12 patients. In 11 patients, the Mules implant was removed with a median size of 16 mm (range: 16–20 mm) and in 4 patients, the silicone implant was removed with median size of 16 mm (range: 16–18 mm). All four extra-ocular muscles could not be identified in any case, so muscles were not sutured with the implant. Bony fossa was formed at the site of migration in 12 patients. A porous polyethylene orbital implant was put in all patients with a median size of 14 mm (range: 12–18 mm). On histopathology, orbital fat revealed atrophy in all patients and the pseudocapsule was found to be composed of fibrocollagenous tissue [Figure 1a and b].

Postoperatively, pain was assessed by the visual analog scale score (1–10). The mean ± SD score of pain was 5.2 ± 0.86 (range: 4–6) on the first postoperative day, which subsided completely on the seventh day of follow-up. There was no case of wound dehiscence, hematoma, implant exposure, or extrusion. Recurrence of migration was present in one patient at 1 month of follow-up. Significant enophthalmos (>2 mm) was present in 2 patients in the second month of follow-up. Pseudoptosis (>2 mm) was present in 2 patients in the second month of follow-up. The mean ± SD depth of the inferior fornix in the second, third, and sixth months of follow-up was 6.5 mm ± 0.81, 6.9 mm ± 0.56, and 7.2 mm ± 0.63, respectively, in all except one patient who had recurrence of migration. Fourteen patients were able to wear the prosthetic eye within the follow-up of 2 months. The mean overall motility of the prosthesis was calculated by calculating the average motility in all four gazes. The mean ± SD of overall motility was 0.89 mm ± 0.24, 1.26 mm ± 0.31, and 1.95 mm ± 0.32 in the second, third, and sixth months of follow-up, respectively, and this increase was statistically significant ($P < 0.001$). In the sixth month of follow-up, the mean motility of the prosthesis was 26% of the normal eye [Table 1]. Satisfaction was good in 10 patients and fair in 5 patients as graded by parents or guardians in 6 months of follow-up [Figure 2a-d].

The patient with recurrence of migration underwent replacement of the implant with a dermis fat graft, following which he could wear the artificial eye.

DISCUSSION

The major disadvantage of non-porous spherical orbital implants such as Mules and silicone implants is that they do not biointegrate. Hence, one of the common complications of these implants is migration, reported in 10–15% of patients.[6] These implants are cheaper than porous implants, therefore commonly used in our set-up in patients with lower socioeconomic status undergoing enucleation for retinoblastoma. In the Western world, porous implants such as hydroxyapatite, porous polyethylene, and aluminum oxide are commonly used, which biointegrate and are associated with almost nil risk of migration.[7-9] Hence few reports are available in the world literature on the management of implant migration. To the best of our knowledge, no prospective study is available so far on the management of implant migration. We conducted this study to evaluate the outcome of porous polyethylene orbital implants in anophthalmic sockets with migrated non-porous implants. We chose porous a polyethylene orbital implant to replace the migrated implant because the reported risk of migration with a porous implant is almost nil.[7-9] The reasons are its rough

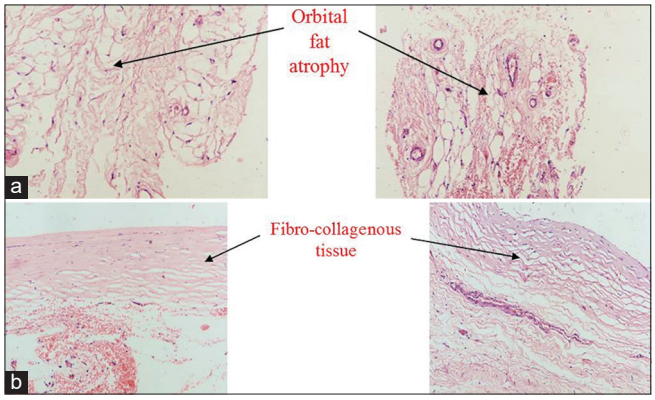


Figure 1: (a) Fat microphotograph shows atrophy of orbital fat (H&E). (b) Microphotograph shows the pseudocapsule composed of fibrocollagenous tissue

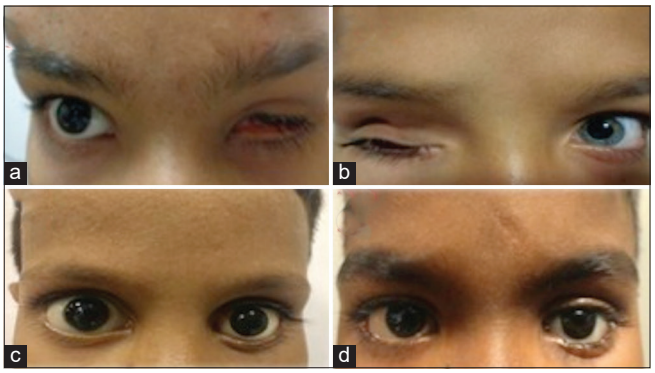


Figure 2: (a) Preoperative picture of a patient with a left-eye anophthalmic socket with inferior implant migration. (b) Postoperative picture of the same patient after fitting the artificial eye. (c) Preoperative picture of a patient with a left-eye anophthalmic socket with inferior implant migration. (d) Postoperative picture of the same patient after fitting the artificial eye

Table 1: Prosthesis motility with respect to the normal eye

	Motility - Mean+SD (mm)				
	Adduction	Abduction	Elevation	Depression	Overall motility
Prosthesis motility at sixth month follow up	2+0.46	2.1+0.33	1.56+0.31	2.13+0.29	1.95+0.32
Normal eye motility	8.33+0.48	8.33+0.48	5.33+0.48	8.33+0.48	7.58+0.48
Mean difference	6.23+0.67	6.33+0.59	3.76+0.56	6.2+0.59	5.63+0.58
Percentage of normal motility (%)	24.07+5.63	25.27+4.27	29.55+6.25	25.69+3.87	25.80+4.52

porous surface which does not allow slippage of the implant in between the tissues in the early postoperative period and fibrovascular ingrowth in the late postoperative period.

Fifteen patients with a mean age of 8.33 years who had anophthamic sockets with implant migration were enrolled in the study. All patients had undergone enucleation with orbital implants for retinoblastoma. All these patients could not afford a porous polyethylene orbital implant during primary surgery. In primary surgery, a Mules implant was placed in 11 patients with a median size of 16 mm (range: 16 to 20 mm), and a silicone implant was placed in 4 patients with a median size of 16 mm (range: 16 to 18 mm). Ten patients had a recurrence of implant migration after implant repositioning surgery. The most common site of implant migration was inferior contrary to the hypothesis that the Lockwood ligament presents inferiorly and retracted obliques nasally support the implant, so the implant usually migrates super-temporally into the space between the superior rectus and lateral rectus in the path of least resistance.[10]

The migrated implant was replaced with a porous polyethylene orbital implant in all patients. We could not find all four rectal muscles in any patient, so muscles were not sutured to the implant, presuming that if we do not suture all the rectal muscles, then contracture and pulling forces of sutured muscles could lead to the recurrence of migration in the direction of pulling forces. We strongly believe that closure of the fossa created by the migrated implant and formation of a cavity in the center helped in the proper centration of the implant in our cases. Fornix formation was required in all patients. On histopathology, orbital fat atrophy was present in all patients which supports the hypothesis of post-enucleation syndrome where fat atrophy is thought to be one of the contributing factors to the loss of orbital volume.[11] In the majority of the patients, we found a pseudocapsule around the implant, which was composed of fibro-collagenous tissue; this could be because of a mild grade of inflammation around the implant in the postoperative period.

In the current series, recurrence of migration was present in only one patient in one month of follow-up. Fourteen patients were able to use the readymade artificial eye within two months of follow-up. There was a significant improvement in prosthesis motility until follow-up of 6 months, probably because of better integration of the implant with the surrounding tissues with time, resulting in better transfer of motility to the prosthesis. However, the overall mean motility (26% of the normal eye) was less than expected probably because we could not suture muscles with the implant in any patient, and as a result, there was no integration with the extra-ocular muscles. We could not find all four extra-ocular muscles in any patient, probably because of fibrosis and retraction of muscles because of the long duration of primary surgery and repeated surgeries in the majority of the patients.

The complications of porous polyethylene implants in our study were minimal. None of our patients had implant exposure, which is considered to be a common complication of porous implants.[7-9] Significant enophthalmos and pseudoptosis were present in 2 patients, respectively. This could be because none of our patients could afford custom-made artificial eyes, which are designed to take care of enophthalmos, ptosis, and motility to some extent. Its use also improves the overall cosmetic satisfaction of the patient.[12] In most of the studies on use of porous polyethylene implants in the enucleation procedure, the reported surgical complications are lower eyelid malposition (entropion or ectropion) in 0.8–22.7%, blepharoptosis in 0.34–18.2%, enophthalmos in 0–4.5%, infection in 0–1%, implant exposure in 0–4.5%.[7-9] The reason for the recurrence of migration in one patient could be sagging of the implant again in the same space. The patient was not able to wear the prosthesis because of shelving of the inferior fornix due to inferior and anterior migration of the implant. Therefore, the implant was removed and a dermis fat graft was placed to provide the volume along with fornix formation sutures. After 2 months of the surgery, the patient was able to wear the artificial eye.

To conclude, the use of porous polyethylene implants in patients with migrated non-porous implants has encouraging outcomes with minimal risk of recurrence. By the end of the study, most of the patients were satisfied with the cosmetic outcome.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Assessment of safety profile of phacoemulsification in hard cataract

ABSTRACT

Purpose: The aim of the study was to assess safety of phacoemulsification in hard cataract by evaluating the post-operative endothelial cell loss and visual acuity. **Materials and Methods:** This is a hospital-based, prospective study conducted on 70 eyes of 70 patients with hard cataract. At the time of admission, detailed evaluation of anterior segment using slit lamp bio microscopy was done and cataract graded using LOCS III. Posterior segment was evaluated using indirect ophthalmoscopy under 20D/B-Scan. All patients with hard cataract underwent phacoemulsification procedure. The visual acuity and endothelial cell density assessed using Snellens chart and specular microscopy pre-operatively and post-operatively on Day 1, Day 7, and Day 30, respectively. Descriptive statistics, namely, mean, standard deviation to express continuous variables wherever applicable. Correlation between endothelial cell loss and cataract grading and correlation between final endothelial cell loss and final best-corrected visual acuity (BCVA) is analyzed by using Pearson's Chi-square test and Pearson's correlation coefficient. *P* value <0.05 is considered as statistically significant. **Results:** Among 70 eyes, 40 (57.1%) had NO4-NC4, 18 (25.70%) had NO5-NC5, and 12 (17.1%) had NO6-NC6 cataract grading. The endothelial cell loss was 4.28%, 6.19%, and 7.15% on post-operative day 1, 7, and 30, respectively. There was a positive correlation showing that, as the cataract grading increased the endothelial cell loss increased too. The BCVA of 6/9 was achieved in 2 (2.8%), 6/6 in 68 (97.2%) at the end of four weeks. **Conclusion:** Although density of cataract has unfavorable influence on early post-operative corneal endothelial cell loss, it did not significantly influence final BCVA. The technique of phacoemulsification for hard nuclear cataract is worthy to be spread due to safety, effectiveness with good visual outcomes.

Keywords: Best-corrected visual acuity, endothelial cell loss, hard cataract, LOCS III, phacoemulsification

INTRODUCTION

Cataract being defined as either developmental or acquired opacification of lens or capsule is one of the leading causes of blindness especially in the developing world like India where it is responsible for 50-80% of bilateral blindness, however at the same time it is the one of the most common treatable blindness in the world.[1,2]

The nuclear cataract being the most common form of age-related cataract is a major cause of ocular morbidity in our country.[3] In developing countries, patients present with hard cataract commonly due to lack of awareness, lack of feasibility to healthcare centers, etc.

A surgical intervention using phacoemulsification technique which is a procedure where an ultrasonic device is used to break up and then remove a cloudy lens or cataract from eye to improve vision will be used in the study.

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The Lens Opacities Classification System (LOCS III) was introduced in 1993 as a subjective grading system for cataract using slit lamp, with accuracy comparable to objective methods.[4] Hard cataract is usually seen in advanced stages of cataract formation. The nuclei achieve maximum density at such advanced stage.[5]

Although hard cataracts possess above average challenges for phacoemulsification surgeon, they also offer potential for a greater restoration of vision and the quality of life for patient when performed successfully.[5] The harder nucleus will require a longer time and higher power of phacoemulsification.[6] Longer phacoemulsification time at higher energy levels increase the risk of corneal endothelial damage due to increased thermal injury to cornea.[7]

This study is being taken to assess the visual acuity and corneal endothelial count in patients with hard cataract after surgical intervention using phacoemulsification technique and to assess the safety of phacoemulsification in hard cataract based on the post-operative best-corrected visual acuity (BCVA) and corneal endothelial cell count.

Aims and objectives

To assess the safety of phacoemulsification procedure in hard cataract by evaluating corneal endothelial cell loss and post-operative visual outcome.

MATERIALS AND METHODS

This is a hospital-based, prospective study conducted in a tertiary eye care hospital in South India from November 2018 to May 2020 on 70 eyes of 70 patients with hard cataract (NO4 NO6–NC4 NC6). Following approval and clearance from institutional ethics committee, the participants were enrolled for the study after applying the inclusion and exclusion criteria. Patients with hard cataract (NO4 NO6–NC4 NC6) and specular endothelial count more than 1500/mm2 pre-operatively were included in the study after obtaining written informed consent. Participants were excluded when valid consent was not obtained or any evidence of subluxation, pseudoexfoliation, any associated ocular pathology, unavailability to follow-up, history of previous ocular surgery was present.

The demographic data, that is, name, age, gender, and history was recorded using a pre-fixed questionnaire which included duration of decrease in visual acuity, associated systemic illness such as hypertension, diabetes mellitus, and ischemic heart diseases. As a part of pre-operative work up, all patients had a complete ocular examination including visual acuity assessment, grading of lens to determine the density, detailed fundus examination, corneal endothelial cell density, and biometry.

Both uncorrected visual acuity (UCVA) and BCVA assessed using snellens chart. Anterior segment examined using slit lamp biomicroscopy and fundus examined by indirect ophthalmoscopy under 20D/B-Scan ultrasound (US) to determine whether the posterior pole anatomy is grossly normal when the lens opacity obscures a view of the retina and optic nerve. Grading of cataract pre-operatively was done using LOCS III.

The Lens Opacities Classification System version III (LOCS III) is an accurate standardized photographic comparison of standard images of 8.5-inch x 11-inch used at the slit-lamp microscopy for grading the type and severity of cataract. The brightness of scatter from the nuclear region has been designated nuclear opalescence (NO) and the intensity of brunescence, nuclear color (NC). The amount of cortical cataract and the estimated amount of posterior subcapsular cataract is determined by comparing with standard images.[8] The greater the LOCS III grade for NO and NC, the more likely it is that the nucleus will be sclerotic.[9]

Biometry done using IOL Master 700 or A-scan and Auto keratometer (shinipon) whenever IOL Master could not pick up the readings. While the endothelial cell density was measured using specular microscope (Toney EM 3000). Visual acuity and corneal endothelial cell density was assessed pre-operatively and post-operatively on day 1, day 7, and day 30.

All surgical procedures were performed by a single surgeon. Pre-operative mydriasis was achieved using tropicamide 0.5% eye drops, phenylephrine 5% eye drops, and Flurbioprofen 0.03% eye drops to prevent intra-operative miosis. Peribulbar block given to the patient. After a povidone iodine scrub to the lashes and eyelids, a closed loop lid speculum was placed. A clear corneal self-sealing incision made with a 2.8 mm keratome knife at the steep axis. Two side ports made and air bubble injected into the anterior chamber and anterior capsule stained with tryphan blue. Continuous curvilinear capsulorrhexis was carried out with a bent 26-gauge needle. Hydrodissection/hydrodelineation was performed to separate the nucleus from the bag and free rotation of the nucleus was ensured. Phacoemulsification of the nucleus was done by stop and chop technique. Bimanual irrigation and aspiration was performed. A foldable intraocular lens was inserted through the main port into the capsular bag. Residual viscoelastic was removed. The clear corneal wound was sealed by hydration. Subconjunctival antibiotic injected. Eye was patched.

Topical antibiotic with steroid given hourly for first 24 hours post-operatively followed by tapering dosage every week for six weeks. Post-operative assessment of visual acuity and endothelial cell density of the patient was carried out on first post-operative day, one week, and after one month following surgery. BCVA, that is, with refraction and correction is calculated at the end of follow-up on POD 30.

Statistical analysis

The data collected was entered into MS Office Excel sheet and was analyzed using SPSS 20.0 version. Sociodemographic data such as age, gender, co-morbidities, grading of cataract, pre-operative visual acuity, post-operative BCVA readings are presented using descriptive statistics, namely, mean, standard deviation, frequency, and percentage. Correlation between endothelial cell loss and cataract grading and correlation between final endothelial cell loss and final BCVA is analyzed by using Pearson's Chi-square test and Pearson's correlation coefficient. *P* value <0.05 is considered as statistically significant. Data is presented in the form of tables and graphs whenever necessary.

Sample size estimation

The sample size is calculated based on the previous study by James A Davison.[10]

Sample size was calculated using the formula $\frac{n = Z\alpha^2\sigma^2}{d^2}$

Where,

Zα is the confidence interval at 95% (standard value of 1.96)

σ is standard deviation (0.2)

d is the absolute precision

$$n = \frac{(1.96)^2 \times (0.2)^2}{(0.05)^2}$$

n = 62

Assuming 10% loss to follow-up, the final sample size calculated is 70.

RESULTS

During the study period from November 2018 to May 2020, a total of 70 patients were evaluated and were deemed fit to undergo cataract surgery. The patients have undergone phacoemulsification procedure. In the post-operative period, the visual outcome and corneal endothelial cell loss were noted and the data was analyzed.

The study consisted of 70 cases out of which 36 (51.4%) were males and 34 (48.6%) were females The mean age at presentation was 63.67 ± 9.72. of which 40 (57.1%) patients had NO4-NC4, 18 (25.7%) patients had NO5-NC5 and 12 (17.1%) patients had NO6-NC6 grading of cataract at presentation.

The mean endothelial cell count pre-operatively was 2619.81 ± 94.172. The mean endothelial cell density was 2507.49 ± 95.625 on post-operative day 1 with 4.28% of cell loss, at the end of post-operative week 1 was 2457.59 ± 92.359 with 6.19% of cell loss from the base line and at the end of one month the mean endothelial cell density was 2432.40 ± 117.72 with 7.15% of cell loss from the base line. Table 1 depicts mean cell loss at different periods of follow-up.

Table 1 shows the co-relation between cataract grading and final endothelial cell loss (POD 30) and the statistical test used is Pearson's correlation coefficient, it Where r (Pearson's correlation coefficient) = 0.516, since it is positive, it has positive co-relation showing that as the grading of cataract increases chance of endothelial cell loss increases after phacoemulsification. Since *P* value is 0.0001, that is, *P* value <0.05, it is statistically significant.

The BCVA of 6/9 was achieved in 2 (2.8%) and 6/6 in 68 (97.2%) and NIL patients with visual acuity of >6/12.

In Table 2, the statistical test used is Pearson's correlation coefficient, it shows the co-relation between final endothelial cell loss (POD 30) and BCVA, r = 0.036 shows a positive co-relation, but *P* value = 0.770, that is, *P* value >0.05, that is, statistically not significant. Hence, even though there is endothelial cell loss it is not to an extent to hamper the vision.

Table 1: Table showing correlation between endothelial cell loss and cataract grading

	Correlations	
	Grading	**Endothelial cell loss on post-operative Day 30**
Grading		
Pearson's correlation	1	0.516**
Sig. (2-tailed)		0.000
n	70	70
Endothelial cell loss on post-operative Day 30		
Pearson's correlation	0.516**	1
Sig. (2-tailed)	0.000	
n	70	70

**Correlation is significant at the 0.01 level (2-tailed).

DISCUSSION

Corneal transparency is regulated by corneal endothelial pump function that can be disrupted by the surgical trauma. A high degree of surgical skill and accuracy in performing the operating technique are essential in reducing endothelial cell damage. Many factors such as nuclear density, mechanical contact with nuclear fragments/instruments or higher ultrasound energy can increase cell loss. Phacoemulsification is the preferred technique for the cataract surgery but few studies found out that there is increased endothelial loss in higher grades of cataract. With this background, the results of the study were analyzed and discussed.

In our study, 40 (57.1%) patients had NO4-NC4, 18 (25.7%) patients had NO5-NC5 and 12 (17.1%) patients had NO6-NC6 grading of cataract at presentation while in a study conducted by Ilavska M *et al.*[11] on 57 eyes of hard cataract 5 (8.7%) had NO4 NC5, 8 (14.03%) had NO5-NC5 and 43 (75.43%) had NO6-NC6.

In the current study, the mean pre-operatively endothelial cell count of 2619.81 ± 94.172 per mm^2. In the study conducted by Siddique MA the mean pre-operative endothelial cell count was 2745.35 ± 395.27 (SD) per mm^2.[12] These findings nearly correlate with the findings of current study.

Corneal endothelial cell damage can induce corneal decompensation following phacoemulsification and the endothelial cell loss is an important prognostic factor for assessing the outcome of the surgery. In our study, mean cell loss between pre-operative value and different periods of follow-up are 4.28% on post-operative day 1 which further continued to 6.19% on post-operative week 1 and at the end of post-operative month 1, the mean endothelial cell loss was 7.15%. In a study by Siddique MA, the mean endothelial cell loss from baseline was 5.84%, 6.58%, and 7.29% at the first POD1, week 1 and 1 and half months after surgery.[12] These findings nearly correlate with the findings of the current study. James A Davison *et al.*[13] in his study showed the mean endothelial cell density loss was 4.1%–10.8%.

Table 2: Shows correlation between final endothelial cell loss and BCVA

Correlations		
	Endothelial cell loss on post- operative Day 30	BCVA POD 30
Endothelial cell loss on post-operative Day 30		
Pearson's correlation	1	0.036
Sig. (2-tailed)		0.770
n	70	70
BCVA POD 30		
Pearson's correlation	0.036	1
Sig. (2-tailed)	0.770	
n	70	70

Study conducted by Ken Hayashi *et al.*[14] concluded that the firmness of the nucleus as the most significant risk factor for endothelial cell loss. In another study by Lee *et al*.,[15] the percentage of endothelial cell loss correlated with the grade of nuclear opacity with a mean of 9.97% (for grade II) to 12.03% (for grade IV). Uniformly, in our study, the percentage of endothelial cell loss increased with increasing nuclear cataract as shown by the positive correlation as shown in Table 1.

In current study, the final BCVA of 6/6 was achieved in 68 (97.2 patients) and 6/9 in 2 (2.8%), that is, in our study 100% had BCVA of 6/12 or better. The study by Wilczynski M *et al.*[16] showed similar results of 100% of vision acuity 6/12 or better. Zhu S *et al*.[17] in their study reported visual acuity of 6/12 or better in 98.4%. These findings are similar to the findings of the present study.

As shown in Table 2, the co-relation between final endothelial cell loss (POD 30) and BCVA by Pearson's correlation coefficient, r = 0.036 shows a positive co-relation, but *P* value = 0.770, that is, *P* value >0.05, that is, statistically not significant. Hence, even though there was a moderate amount of endothelial cell loss, that is, mean endothelial cell loss was 7.15% it was not to an extent to hamper the vision. In this study, no patient suffered from endothelial decompensation because all the patients had good endothelial cell count pre-operatively and single competent phaco surgeon operated all the cases.

CONCLUSION

Although density of cataract has unfavorable influence on early post-operative corneal endothelial cell loss, it did not significantly influence the visual function as depicted from visual acuity records in follow-up periods, provided the endothelium is healthy and the number is above the threshold limit. Thus, the technique of phacoemulsification for hard nuclear cataract is worthy to be spread due to safety, effectiveness with good visual outcomes.

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Conflicts of interest

There are no conflicts of interests.

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Original Article

A comparative study of spectral domain optical coherence tomography (SD-OCT) showing presence and characteristics of intraretinal hyperreflective foci in patients of normolipemic xanthelasma palpebrarum as compared to healthy subjects

ABSTRACT

Background and Objectives: Hyperreflective foci (HRF) are a morphological sign of accumulation of lipid extravasation, proteinaceous material, and inflammatory cells in the layers of retina. The purpose of this study is to determine the presence, location, and characteristics of hyperreflective foci in the retina of normolipemic patients with xanthelasma palpebrarum. **Methods:** A total of 50 test subjects with xanthelasma were evaluated and compared with 50 control subjects. SD-OCT was performed in all patients passing through the center of fovea. On OCT, presence and absence of hyperreflective foci were noted. Following characteristics of the hyperreflective spots were evaluated and compared: location (inner retina or outer retina), shape, size, and back shadowing. **Results:** Hyperreflective foci were present in 87 out of 100 eyes of test subjects (87%) and none in control group (P-value < 0.001, significant). Shape of hyperreflective foci was predominantly round (54.2%), and location of hyperreflective foci was predominantly in outer nuclear and outer plexiform layer (30.1%). Back shadowing was present with frequency of 58 (80.6%). **Conclusion:** Hyperreflective foci are a great indicator for lipid extravasation and have been significantly associated with patients of xanthelasma having normal lipid levels. This signifies a defect in vascular integrity in patients of xanthelasma with normal lipid levels. Hence, these patients are at increased risk of atherosclerotic plaque formation and systemic complications.

Keywords: Hyperreflective foci, Spectral domain optical coherence tomography (SD-OCT), xanthelasma

INTRODUCTION

Xanthoma is a common manifestation of lipid abnormality, the most common of which is xanthelasma palpebrarum (XP). Generally, it is seen in middle-aged females. Incidence is 1.1% in females and 0.3% in males. It presents as symmetrical, soft, yellowish, velvety papules and plaques on the lower and upper eyelids.[1-4] XP is classically associated with increased risk of atherosclerotic cardiovascular diseases. Reported prevalence of atherosclerotic cardiovascular diseases among patient of xanthelasma varies between 15 and 70%.[5] It is accepted that xanthelasma in hyperlipidemic patients is associated with higher LDL and lower HDL levels. In normolipidemic patients, there are factors like increased vascular permeability, lipid synthesis, and macrophage uptake which can cause xanthelasma.[6]

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Hyperreflective foci are a morphological sign of accumulation of lipid extravasation, proteinaceous material, and inflammatory cells, and consequently precursors of hard exudates.[7,8] They are deposited primarily in the outer plexiform layer (OPL) and outer nuclear layer (ONL) of the retina.[9] SD-OCT offers three-dimensional information about the extent and distribution of hyperreflective lesions throughout the retinal layers.

The resolution of SD-OCT is in the range of 5–7 μm and, thus, has the potential of imaging leukocytes which can be up to 10–30 μm in size.[10] These leukocytes would appear as hyperreflective foci in the vitreous in the SD-OCT images. Saito *et al*. characterized hyperreflective foci as dots that were larger and brighter than the "usual background speckle," and they noted an increase in the density of the foci closer to areas of retinitis.[11]

HRFs are observed in some retinal diseases, such as age-related macular degeneration, retinal vein occlusion, central serous choroidoretinopathy, Stargardt disease, retinitis pigmentosa as well as DR.[12] The pathologic association of HRF with disruption of the outer retina and poor visual acuity suggests that these are clinical markers of outer blood retinal barrier and consequent photoreceptor dysfunction.[13]

The present study was done at our tertiary care center to assess the presence of hyperreflective foci and their characteristics like size, shape, distribution in the retina of patients suffering from xanthelasma palpebrarum and compare it with age-matched control group. Characteristics of these hyperreflective foci were measured on spectral domain OCT (Cirrus HD OCT MODEL 400).

OBJECTIVES

1. To study the presence of hyperreflective foci in patients of xanthelasma palpebrarum with normal lipid levels and compare with normal population.
2. To identify and describe the various characteristics of these hyperreflective foci.

METHODOLOGY

This was a cross-sectional comparative study carried out at tertiary care ophthalmic center in northern India. All patients reporting with xanthelasma palpebrarum with normal lipid levels were taken as test subjects, and age-matched control groups were taken without xanthelasma palpebrarum. Approval from ethics committee taken on 24 March 2022

Eyes undergo full ophthalmological examination including best corrected visual acuity, slit-lamp biomicroscopy, optical coherence tomography (OCT), and fundus photography.

The presence of hyperreflective foci was directly observed from SD-OCT. Features such as total number of hyperreflective foci, location, distribution, shape, and back shadowing were noted. All examinations were performed during routine out-patient visit. Four independent ophthalmologists have checked and confirmed the presence/absence of hyperreflective foci, size of the HRF was noted with the help of digital scale passing through center of the HRF, and an average of four readings were taken.

RESULTS

In the present study, analysis of ophthalmic data collected from 50 xanthelasma palpebrarum patients [Figure 1] was compared with a control group of 50 people without xanthelasma palpebrarum. **Out of 50 patients of xanthelasma palpebrarum, 60% were males and 40% were females.** The mean age of participants was 45.38 ± 8.09 years. **Hyperreflective foci were found in 87 eyes (87%).**

The following observations are made:

Number of hyperreflective foci – Out of 100 test subjects' eyes examined, 87 eyes showed presence of hyperreflective foci ($P < 0.001$, significant) [Table 1]. Control group showed no hyperreflective foci in the SD-OCT scans.

Location of hyperreflective foci – Although the distribution of these hyperreflective foci was seen extending from outer nuclear layer to inner plexiform layers, these foci were predominantly located in outer nuclear and outer plexiform layer (30.1%) [Figure 2], which depicts the location of hyperreflective foci.



Figure 1: Photograph of a patient with bilateral xanthelasma palpebrarum

Table 1: Comparison between case and control

No	Group 0		Total	*P*	Significance
	Case	Control			
Hyperreflcetive foci					
0	13 (13)	100 (100)	113 (56.5)	<0.001	Significant
1	60 (60)	0 (0)	60 (30)		
2	21 (21)	0 (0)	21 (10.5)		
3	6 (6)	0 (0)	6 (3)		
Total	100 (100)	100 (100)	200 (100)		

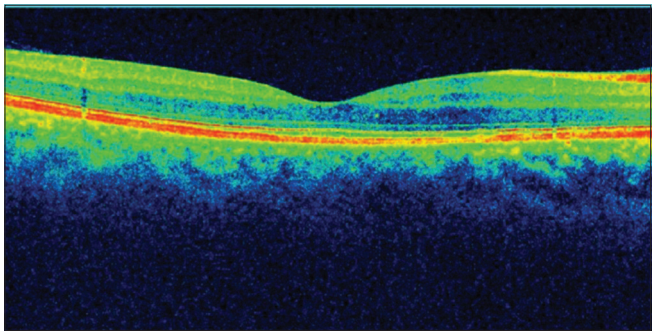


Figure 2: Optical coherence tomography depicting the hyperreflective foci and its presence in patients with xanthelasma palpebrarum

Shape of hyperreflective foci - Greater number of round-shaped hyperreflective foci 54.2% were observed in eyes with xanthelasma palpebrarum.

Back shadowing - Back shadowing was seen in 80.6% (58 eyes).

The presence of hyperreflective foci was found **in 87** % of eyes. The majority of HF was round-shaped (**54.2%**), and the remaining foci were of various shapes like irregular (18.8%), oval (5.2%), and both (17.7%). In 4.1% of eyes, hyperreflective foci shape could not be determined. Back shadowing was present in **80.6%** of eyes.

In our study sample, hyperreflective foci were present in 87% of eyes with xanthelasma palpebrarum and in no eyes without xanthelasma palpebrarum which was statistically significant. ($p < 0.01$).

DISCUSSION AND CONCLUSION

In this study, we evaluated 100 patients, i.e., 50 patients with xanthelasma and normal lipid levels vs. 50 control patients without xanthelasma and normal lipid levels. Out of 100 eyes of test subjects, 87 eyes were found to have HRF. Out of **100 eyes of control subjects**, no one was found to have hyperreflective foci. Out of 50 test subjects, 30 subjects were male and 20 subjects were female with a mean age-group of 45.38 yrs. Control group also contained 20 females and 30 males.

Hyperreflective foci are a morphological sign of accumulation of lipid extravasation, proteinaceous material, and inflammatory cells, and consequently precursors of hard exudates.[7,8] Hyperreflective foci are present in various ocular conditions like ARMD, diabetic retinopathy, CRVO, macular edema, etc., Presence of a thorough literature search on the correlation between xanthelasma and hyperreflective foci showed no studies done so far. Hyperreflective foci are a great indicator for lipid extravasation, and in our study, it has been significantly associated with patients of xanthelasma having normal lipid levels. This signifies a defect in vascular integrity rather than elevated lipid levels in patients of xanthelasma. Hence, these patients are at increased risk of atherosclerotic plaque formation in multiple vessels in the body and should be evaluated further to prevent any vascular life-threatening consequences in the future.

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Secondary glaucoma after vitrectomy and phaco-vitrectomy surgeries. A tertiary care experience

ABSTRACT

Purpose: To determine secondary glaucoma post vitrectomy and phaco-vitrectomy surgeries with or without silicon oil, gas, or scleral buckle. **Materials and Methods:** Ninety eight eyes from 84 patients (52 males and 32 females) were included. Preoperative intra ocular pressure (IOP) values were compared with postoperative values at the first postoperative day, one week, one month, and three months and were classified as per intraoperative techniques. **Results:** Patients who underwent Pars plana vitrectomy with silicon oil plus buckle and patients with Pars plana vitrectomy, gas, and buckle had 70% and 100% high IOPs, respectively, on the first postoperative day. Twenty four percent of eyes who had silicon oil injected had higher IOP compared to 11.0% who had no silicon oil. 25% of eyes who had buckle implanted had higher IOP as compared to 12.8% without buckle. At the end of 3 months, 20% of patients who underwent vitrectomy with silicon oil and laser with buckle, 30%, of eyes with gas and laser, and 20% of eyes with oil and laser were found to have high IOP. Hundred percent of eyes with gas, laser, and buckle had the highest increase of IOP on the first postoperative day, followed by oil, laser, and buckle-70 percentage and gas with vitrectomy alone-42.9 percentage. **Conclusion:** Secondary glaucoma remains to be an important complication in patients undergoing vitrectomy. Patients who undergo vitrectomy with gas plus oil and buckle may have significantly more chances of developing high IOP and hence advisable to consider aggressive and close management.

Keywords: Pars plana vitrectomy, scleral buckle, secondary glaucoma, silicon oil

INTRODUCTION

Secondary glaucoma is one of the most commonly occurring complications following any retinal surgery often ranging from 19% to 28% of all cases.[1,2] It may occur either in the immediate, early, or late postoperative period. The reason may be either underlying predisposition to develop raised intra ocular pressure (IOP), like Wagner, Stickler's disease, and retinitis pigmentosa[3-5] or it can be a complication of retinal surgeries, external, or internal procedures like scleral buckling and vitrectomy with tamponade agents like gases and silicon oils. This pressure raised can be transient or sustained.

The cause of this glaucoma may either be underlying predisposition to develop glaucoma, for example, Stickler's, Retinitis Pigmentosa, and Wagner, or may be due to complication following vitreoretinal procedure.[3,5] The current treatment modalities for this glaucoma include both medical and surgical procedures with possible use of antimetabolites or filtration tubes. In refractory cases, the use of cyclo-ablation treatment has been described.[6]

MATERIALS AND METHODS

This was a retrospective cohort study, which included 98 eyes of 84 patients (52 males and 32 females). Their ages ranged from 18 to 84 years with a mean of 53.68 years. Age and gender as a factor was not statistically significant [Table 1].

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All the eyes had no pre-existing glaucoma. Preoperative and postoperative IOP was noted from the patient's charts.

Eyes were considered to have secondary glaucoma if the postoperative IOP was more than 21 mm of Hg on Goldman's applanation tonometry.

Secondary glaucoma was noted in 30.6% of the total number of all cases involving different procedures with Pars plana vitrectomy (PPV) as discussed below.

Four eyes underwent PPV alone. Mean IOP did not vary to show any statistical significance. Two eyes underwent PPV with gas and buckle and showed mean IOP increasing from 18.00 mm of Hg to 29.50 mm of Hg on first postoperative day. They were medically treated and IOP reached to 11 mm of Hg by the end of first month, which was statistically significant (*P*. 017).

Ten eyes which underwent PPV with oil and buckle had mean IOP increasing from 14.40 mm of Hg to 24.10 mm of Hg on day 1 postoperatively. Thirty five eyes underwent gas with laser (preoperative mean IOP 16.25 mm of Hg; postoperative mean IOP 17.97 mm of Hg), 15 eyes underwent oil with laser (preoperative mean IOP 15.60 mm of Hg to16.67 mm of Hg), and 25 eyes had PPV with laser with no statistically significant change in IOP. Seven eyes underwent PPV with gas had mean IOP increased from 13.14 mm of Hg to 21.29 mm of Hg.

RESULTS

Among the combination of procedures done, 70% and 100% of the eyes, which underwent PPV with silicon oil and buckle and patients with gas and buckle had high IOPs, respectively, on the first postoperative day. Twenty four percent of eyes which had oil injected had higher IOP compared to 11.0% who had no oil and 25% of the eyes who had buckle implanted had higher IOP as compared to12.8% who had no implantation.

At the end of 3 months, 10.2% of all eyes had still raised IOP requiring intervention. Leading the list were eyes which had PPV with oil and laser (13.3%) followed by eyes with PPV and laser alone (12%) and eyes which had PPV with gas and laser (8.6%).

Eyes, which underwent surgery with gas, laser, and buckle, had the highest increase of IOP (100%) on the first postoperative day, followed by eyes that underwent surgery with oil, laser, and buckle (70%), and eyes that had gas with vitrectomy alone (42.9%).

Table 1: Types of procedure in number of eyes

Type of Procedure done with PPV	Number (%) of eyes
Endo laser	87 (87.8%)
Phacoemulsification	62 (63.26%)
Gas	44 (44.9%)
None	36 (36.7%)
Silicon oil	25 (25.5%)
360 degree buckle	12 (12.2%)

DISCUSSION

The cause of these secondary glaucomas may either be due to factors which predispose the eyes to develop glaucoma, for example, Stickler's, Retinitis Pigmentosa, and Wagner, or it can be due to a complication, following vitreoretinal procedure.[3,5] The current treatment for the management includes both medical and surgical procedures with use of antimetabolites or filtration tubes. In refractory cases, the use of cyclo-ablation has been described.[6]

The literature gives varied results regarding this common complication. One study which had 222 eyes that underwent retinal surgery showed 8.4% of the eyes had IOP >30 mm of Hg at 5-12 hours postsurgery and 14.9% of them had IOP >30 mm of Hg on the first postoperative day. All the patients had received topical antiglaucoma medication, immediately after surgery

Secondary glaucoma following steroids is mostly transient. However, few patients can develop intractable glaucoma requiring prolonged medical treatment or even surgical intervention. Steroid-induced glaucoma is usually an open angle glaucoma, which occurs usually within weeks of commencing steroids and spontaneously reduces once steroids are discontinued.

Intravitreal steroids are the most common medication used in various conditions like uveitis, diabetes induced cystoid macular edema, and cystoid macular edema secondary to vascular disease of retina, postlaser treatment, and choroidal neovascular membrane management, etc.

Secondary glaucoma following steroids is mostly transient. However, few of them develop intractable glaucoma often requiring prolonged medical treatment or even surgical intervention.

Steroid-induced glaucoma occurs usually within weeks of initiating steroids and reduces spontaneously as discontinued. IOP can rise significantly within a week. Intra vitreal triamcinolone acetonide (IVTA) of 4 mg can increase the IOP in 28%-30% of patients to >10 mmHg in.[7-12] Patients at risk of

developing glaucoma are those who have poor outflow facility, diabetics, and those with family history of glaucoma and myopia. Primary open angle glaucoma occurs in about 4-12 times more commonly in patients with retinal detachment.[10]

In yet another study showed 50% of diabetics had secondary glaucoma within 2 months of IVTA.[13]

In another study with fluocinolone acetonide intravitreal device which continuously delivers low dose of steroids in strength of 0.3-0.4 ug/day over a period of 30 months, showed 77% of these patients needed antiglaucoma medication within 3 years, of which 37% required surgical management.[14]

Scleral buckles, used in cases of retinal detachment to provide external tamponade, alter the shape, rigidity, and geometry of the eye to produce indentation, thereby decreasing the ocular volume, hence raising the IOP. Secondary glaucoma can also occur due to various mechanisms like secondary angle closure[15] that leads to corneal edema and shallowing of the angle and can be due to shallow ciliary body (CB) detachment. In another study, narrowing of the angle has been seen in 50% of cases.[16] The band compresses the vortex veins hence impairing the venous drainage leading to edema of the ciliary body and resulting in anterior rotation, leading to narrowing of the AC. IOP can be raised even due to anterior segment ischemia, due to compression of the posterior ciliary arteries.

Many kinds of expanding gases along with air are used in retinal surgeries to provide internal tamponade like sulphur hexachloride (SF6), Perfluoroethane (C2F6), and Perfluoropropane (C3F8). Most of the gases return to normal within 96 hours to 2 weeks.[17] Most common gases used are C2F6 and C3F8. C2F6 can last in the eye from 96 hours to 2 weeks, whereas C3F8 can last 96 hours to 6 to 8 weeks. Gases raise the IOP instantly and hence should be carefully monitored.

Pars Plana Vitrectomy PPV is associated with internal tamponading agents like liquids, gases, and oil. PPV can raise the IOP within few hours (1 to 2) postsurgery.[18] Tonometry will be erroneous as it will underestimate the actual IOP in these cases by 25% to 79% as per Polinor *et al*.[19] About 35% of patients after PPV develop high IOPs within 48 hours.[20]

The main mechanism being secondary open angle.[20] Secondary angle closure may be seen in about 20% of these cases, due to CB edema, Irido corneal touch, or pupillary block. Neo vascular glaucoma may cause rise in IOP in about 26% patients.[21]

Silicon oil used as internal tamponade may be left in the eye for a long period depending upon the type of pathology. The nature of the oil which is viscous and cohesive force due to its molecular nature exerts resistance to the outflow. Secondary glaucoma in cases of PPV associated with the use of silicon oil is about 3% to 40%.[2,22] The longer the oil remains in the eye the incidence of secondary glaucoma increases from 2.2% to 58% in 6 months.

The pathogenesis being pupillary block, blocked peripheral iridectomy, trabecular meshwork block with the emulsified oil, inflammation, or peripheral anterior synechia. In about 11% of the patients, neovascular glaucoma is the cause in eyes with silicon oil.[23]

CONCLUSION

It is evident from the study that secondary glaucoma remains to be an important complication after posterior segment surgeries, especially those involving gas and silicon oil with or without buckle. It is worth considering antiglaucoma treatment at least in the immediate postoperative period in these cases as spike in the IOP may be deleterious to optic nerve which may eventually affect the final visual outcome.

The results are different when compared to Anderson *et al*., 2006, where only 8.4% had high immediate IOP postoperatively and 14.9% had high IOP (more than 30 mm of Hg). Whereas our study showed 70% of the eyes had high IOPs on the first postoperative day in eyes, which underwent PPV with silicon oil and buckle, and 100% of the eyes, which underwent PPV with gas and buckle. It is to be noted that Anderson *et al*. 2006 reported results on eyes with only PPV.

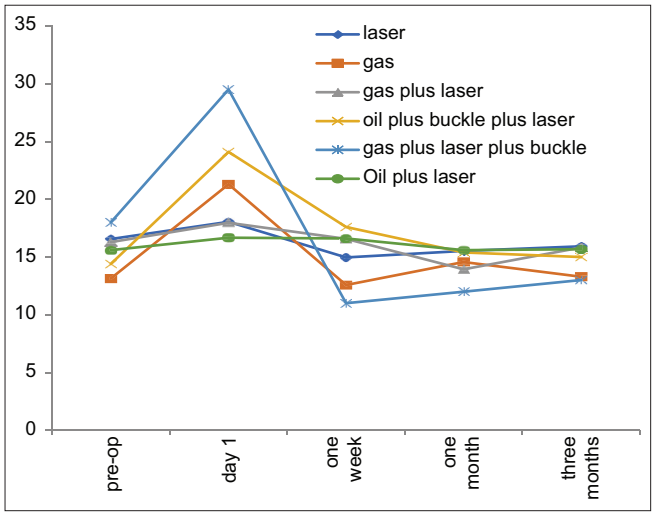
It is evident that the cause of secondary glaucoma after retinal procedures has varied factors. Hence, knowing the cause leads to successful management.

In our study, maximum raise of IOP was seen on the first postoperative day in eyes who had PPV with gas and oil along with buckle [Table 2 and Graph 1]. Hence, we advise to initiate treatment with antiglaucoma medications for eyes surgery with gas or oil injected during PPV. All the eyes had their IOP controlled medically by the end of the first week.

We also have to mention here that all our patients in this study were on oral diamox immediately after surgery. We noticed in this study that patients who had undergone surgery with oil and gas with or without buckle had 20% to 30% chances of uncontrolled glaucoma at the end of third month, which required surgical management. Hence, it is appropriate to counsel these patients of the need of future complex surgeries and also to keep in mind to follow these patients more closely.

Table 2: The different kinds of procedure with number of eyes, and the preoperative and postoperative IOP change in numbers and percentage

Type of Procedure done with PPV	Number (%) of eyes	Percentage of patients having high IOP				
		Preoperative	1st Postoperative	1 week Postoperative	1 month Postoperative	3 months Postoperative
PPV	4 (4.1%)	0%	3 (25%)	1 (25%)	2 (50%)	0%
With Laser	25 (25.2%)	3 (12%)	6 (24%)		1 (4%)	3 (12%)
With gas	7 (7.1%)	0%	3 (42.9%)	1 (14.3%)	0%	0%
With oil plus buckle and laser	10 (10.2%)	15.25	7 (70%)	3 (30%)	1 (10%)	2 (2%)
With gas plus buckle and laser	2 (2%)	1 (50%)	2 (100%)	0	0	0
With Gas plus laser	35 (35.7%)	4 (11.4%)	9 (25.7%)	5 (14.3%)	1 (29%)	3 (8.6%)
With Oil plus laser	15 (15.3%)	1 (6.7%)	2 (13.3%)	3 (20%)	1 (6.6%)	2 (13.3%)
All eyes	98 (100%)	9 (9.2%)	30 (30.6%)	14 (14.3%)	6 (6.1%)	10 (10.2%)
P		0.351	0.01	0.508	0.019	0.824



Graph 1: Graph depicting change of intra ocular pressure in mm of Hg with postoperative period

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Post-pandemic boom: A surprise for ophthalmologists

ABSTRACT

Aim: To compare the statistical supremacy of patients undergoing cataract surgeries at a tertiary eye care center in the pre-COVID versus post-COVID period. **Methods:** A complete audit of patients attending our ophthalmology department and undergoing cataract surgery in a tertiary eye care center was compared between August 2019 to March 2020 (Group A) and August 2020 to March 2021 (Group B). All pertinent ophthalmological parameters were recorded in detail for comparison. **Results:** Average daily OPD attendance in Groups A and B were 146.7 and 111.2 ($P = 0.004$) respectively. However, the average monthly cataract surgery done in these two groups was 88.4 and 121.6 ($P < 0.001$), respectively. The cataract counseling to OT conversion rate was 47% in Group A, whereas that in Group B was 72%. Other eye cataract surgeries have increased from 21% to 39% in the post-COVID era. The emergency cataract surgery rate has also increased by 78%. There was a 66% increase in lens-induced glaucoma cases attending our institution. On comparing the outcome, there has been an increase in the percentage (13%) of aphakia due to an increased number of advanced and challenging cataracts. **Conclusion:** World economy has predicted that there will be a massive revolution in revenue generation in all fields of human resources in the post-pandemic era, coining the term "post-pandemic boom." Similarly, in view of the prevailing uncertainties due to the COVID-19 situation, there has been a steep inclination to seek prompt medical and surgical care for cataracts among patients in ophthalmology.

Keywords: AIOS, cataract, COVID-19, ISBCS, post-pandemic boom

INTRODUCTION

The enforcement of the nationwide lockdown in India since March 23, 2020, posed significant new challenges to the access to healthcare services for patients across the country. On that note, it is an inevitable fact that the health sector has suffered immensely during the pandemic of nationwide lockdown in India with respect to delivering adequate healthcare facilities to the common people.

In the world of ophthalmology, all elective procedures including cataract surgeries and adequate delivery of out-patients department treatment dispensing were severely hampered during the lockdown period. At the same time, due to the lack of easy and safe transportation for patients, many eyes had to go through the dire consequences of late presentation. During the lockdown phase, the most common lens-related issues of patients seeking eye care services were related to acute painful causes, that is, traumatic cataracts and lens-induced glaucoma rather than visual dimness.[1] Cataract being the second leading cause of preventable blindness around the world has also been largely affected. The All-India Ophthalmological Society (AIOS) during the lockdown phase released guidelines for the prospective resumption of cataract surgery, which included triage of emergency cases, use of personal protective equipment, and precautions related to clinical examination and the operating room for facilitating a safe elective cataract screening and surgery. Promotion of access through the use

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of technology modes such as tele-ophthalmology to address all those in need during these challenging times was done.[2] The COVID-19 pandemic has caused unique challenges for ophthalmic practices, which need to adapt to the changing practice patterns influenced by the evolving waves of viral infections.

"Post-pandemic boom" is recent to surface common phrase in the world of the stock market and world economics. During the pandemic when the world came to standstill, all sectors of human resources of different countries were severely affected. However, a majority of renowned economists have predicted that as soon as the pandemic gets over, there would be inflation in revenue generation for a sustainable time period in the corporate and industrial world.

In this study, we have retrospectively looked into the pre-COVID and post-COVID scenarios for the same timeframe with respect to cataract surgeries from both the patients' and healthcare perspectives.

SUBJECTS AND METHODS

The study was designed as a retrospective single-center consecutive case series audit for the International Classification of Diseases, Tenth Revision (ICD-10) final diagnosis codes B18 and B19 encompassing cataract removal, on patients attending the Ophthalmology Department at Midnapore Medical College and Hospital, Paschim Medinipur. The study compared the same time duration of the consecutive 8 months from August 2019 to March 2020 and August 2020 to March 2021, only separated by nationwide lockdown due to the COVID first wave in between. In India, a nationwide lockdown was initiated on March 23, 2020, leading to the postponement of all elective cataract surgeries afterward. In our institution, regular elective cataract surgeries were again started on August 1, 2020. The emergence of the COVID second wave and movement restriction since the early days of April 2021, again led to the downfall of routine cataract services in our institution. Hence, we have carefully considered the timeframe of the study period from August 1, 2020, to March 21, 2021, and compared it statistically with the similar time duration in the recent most pre-COVID scenario from August 1, 2019, to March 21, 2020.

All patients attending OPD during these time periods had undergone routine ophthalmological examinations as required without any restrictions. Those patients who were admitted through emergency were also taken care of and they also had undergone all routine ophthalmological examinations and investigations. These detailed patients' records were then narrowed down with respect to patients seeking cataract surgery during the aforementioned periods.

All socio-demographic data of patients asking for cataract surgery were collected. The official records for daily OPD attendance were collected from the hospital authority. The rest of the information, e.g., the total number of cataract surgeries done, the number of emergency cataract patients admitted, etc., was collected from the departmental record book.

Lastly, all patients were followed up after cataract surgery for 1 month for treatment outcome and during this period all patients who required other eye cataract surgery were verbally counseled for undergoing other eye cataract surgery within the next 1 month of the previous cataract surgery.

All patients in this study were divided into two groups, namely Group A for pre-pandemic patients from August 1, 2019, to March 21, 2020, and Group B for post-pandemic patients from August 1, 2020, to March 21, 2021. All recorded data were compared between these two groups.

The protocol of the study followed the provisions of the Declaration of Helsinki. It was approved by the Local Bioethics Committee at the Midnapore Medical College as a quality assurance project. A waiver of informed consent was approved by the Local Bioethics Committee, given the retrospective nature of the study.

Follow-up procedure

Aside from the visit on the operation day, one preoperative appointment and two follow-up visits (07 and 21 days after the surgery) are scheduled for each patient treated at our institution. Cataract extraction with intraocular lens implantation is performed as a same-day procedure. An additional visit was added to this protocol during the COVID-19 pandemic. Starting on April 23, 2020, in our institution, each patient must undergo preoperative COVID-19 screening with a polymerase chain reaction (PCR) testing 2 days before the surgery and then stay under self-isolation until the procedure. The cost of the preoperative tests was fully covered by the National Health Fund. Any patient who found RT-PCR positive before surgery was counseled for postponement of cataract surgery and cases were operated on afterward as per the patient's wish.

Forecast of cataract surgeries

It was assumed by various organizations that once the elective surgical suspension period gets over, there would be a ramp-up period and the volume of cataract surgeries performed would not immediately revert to 100% of the

pre-pandemic forecast. To model the ramp-up, a stochastic Monte Carlo simulation of a Gompertz function in a manner similar to that described for an elective orthopedic surgical population was used.[3] A Gompertz function is a sigmoid curve with a rapid acceleration phase followed by a plateau phase.[4] It has been previously used to describe a variety of biological growth and recovery phenomena.[5] The rise in the volume of cataract surgeries post-pandemic was forecasted under an optimistic and a pessimistic scenario. Most studies arbitrarily assumed growth velocities of 90% and 50% for the two scenarios, respectively. The growth velocities do not refer to a linear percentage change in surgical volume but are variables in the Gompertz function that affect the non-linear slope of the ramp-up phase. The 90% and 50% were chosen as the bounds of the likely scenario. These assumptions were further tested with sensitivity analyses as described further.

Statistical analysis

Statistical analyses were performed using the SPSS Statistics version 20 software (IBM Corp., Armonk, NY, USA). Results of descriptive analyses are expressed as means ± standard deviations for quantitative variables, and as counts and percentages for categorical variables. A Chi-square test was used to find the association between categorical variables. Pre- and post-comparisons were done using Wilcoxon signed rank test. A *P* value less than 0.05 was considered statistically significant.

RESULTS

In this study, Group A contained 29,563 patients who had attended the Ophthalmology OPD compared to 22,416 patients in Group B. On counting the emergency cases regarding cataract surgery, Group A consists of 43 patients with respect to 76 patients in Group B. The mean age of presentation in Group A was 55.33 ± 9.42 years, whereas that in Group B was 54.26 ± 10.57 years [Table 1].

On comparing the average number of cataract surgeries every month in these two groups, Group A had 88.4 surgeries every month compared to 121.6 surgeries every month in Group B. It has been observed that the counseling to the conversion rate for cataract surgeries in these two periods has shown an increment in Group B (72%) compared to Group A (47%). The patients who were counseled for other eye cataract surgery within 1 month responded positively in Group B (39%) in comparison with Group A (21%) [Figure 1].

On reviewing the emergency surgery data record, it was evident that there was a 78% increase in the number of emergency cataract surgeries in the post-pandemic period compared to the pre-pandemic period. The number of lens-induced glaucoma (LIG) cases increased by 66% in Group B compared to Group A. With the increase in the number of complicated emergency cataract surgeries performed in the post-pandemic period, there has been an inflation of rates of aphakia by 13% to the pre-pandemic period [Tables 2 and 3].

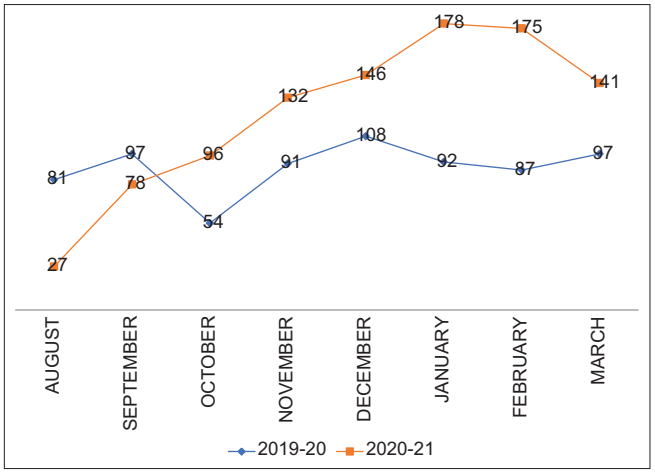


Figure 1: Line diagram showing the total number of cataract surgeries done monthly in Group A and Group B

Table 1: The sex distribution of the population attending the ophthalmology department is elaborated

Group	Male		Female		Total
	OPD	Emergency	OPD	Emergency	
Group A	17,112	135	12,228	88	29,563
Group B	14,679	111	7,561	65	22,416

Table 2: Comparison of numerical details and the percentage of cataract-related emergencies between Group A and Group B

	Group A	Group B	Percentage increase	*P*
Number of emergency cataract surgeries	43	76	78%	0.41
Number of lens-induced glaucoma cases	31	51	66%	0.01
Number of postoperative aphakia	9 (21%)	26 (34%)	13%	0.24

Table 3: A detailed audit of the number of cataract surgeries performed in Group A and Group B with respect to different grades of cataract

Type of cataract	Group A	Group B
Immature senile cataract	536	665
Mature senile cataract	104	189
Hypermature cataract	28	49
Lens-induced glaucoma	31	51
Others (pediatric, traumatic, etc.)	08	19
Total	707	973

DISCUSSION

The results of our study indicate specifically the increased emergence of the necessity of elective cataract surgeries in the post-COVID era compared to the pre-COVID times. The reason is a multifactorial interdependent series of events, primarily starting with the efforts of bridging the gap that the pandemic created, filled by the synchronized efforts from both patients and service providers. During the pandemic's first wave lockdown period, due to the standstill approach for elective cataract surgeries, there has been a huge pile of the backlog of cataract burden increased all over the country. This has raised the efforts of the hospitals to reach out to their target population. At the same time, patients deferring cataract surgeries because of the pandemic duration had faced decreased quality of life with each passing day, compelling them to seek immediate cataract surgeries as soon as the normal service for elective cataract surgeries began. The target geriatric population also was suffering from insecurities regarding further imminent waves of COVID that would refrain them from undergoing cataract surgery in the future.

In our study, it is evident that the number of cataract surgeries increased in Group B compared to Group A significantly ($P < 0.001$) in spite of the fact that the average number of attendances to ophthalmology OPD significantly decreased ($P = 0.004$) due to the emergence of successful tele-ophthalmology services. At the same time, there has been an ease observed in counseling the patients to undergo cataract surgeries ($P = 0.001$) and also in counseling the patients to undergo cataract surgery in the other eye within 1 month of the first surgery.

Due to long-deferred cataract surgeries during the pandemic lockdown period, there has been an increased incidence of emergency cataract cases arriving at our institution in the post-COVID duration. Hence, the amount of LIG has significantly raised attending our emergencies for further management ($P = 0.01$). Due to increased numbers of complicated late presentations of cataract cases in Group B, there was an increased incidence of primary aphakia compared to Group A ($P < 0.24$). These cases of primary aphakia were managed aptly with secondary IOL implantation when needed in the majority of the cases.

Tzamalis *et al*.,[6] in their study, named "The impact of COVID-19 lockdown on cataract surgery: a surgeons' perspective" have shown that the complications rate was 2.09% (5/240 cases) before the abstention and 3.12% (5/160 cases) after the abstention not yielding any statistically significant difference ($P = 0.74$). Also, 37.5% of consultants (3/8) stated that the 2-month abstention from cataract surgeries affected their surgical skills somewhat or a lot, whereas 62.5% (5/8) reported being more careful in their first cases after the lockdown. Most complications occurred in the hands of one surgeon who stated to be very anxious upon restart.

A study named "Impact of Three Waves of the COVID-19 Pandemic on the Rate of Elective Cataract Surgeries at a Tertiary Referral Center: A Polish Perspective" by Dmuchowska *et al*.[7] claimed that during the pandemic, the number of cataract surgeries decreased by 53.4%. The monthly numbers during the first, second, and third waves of the pandemic were 77.5%, 51.5%, and 29.7% lower, respectively, compared with the reference level. No rebound effect was observed once the pandemic restrictions were eased.

Bhalla *et al*.[8] in their study named "Immediate sequential bilateral cataract surgery and its relevance in COVID-19 era" stated that as a result of the COVID-19 pandemic, all elective surgeries were stopped. This has resulted in a large backlog of deferred cataract surgeries. Now more than ever before, we should consider immediately sequential bilateral cataract surgery (ISBCS) as an excellent alternative to delayed sequential bilateral cataract surgery in the right hospital or surgical setting. In the age of COVID-19, it can help to decrease surgical scheduling and follow-up visits.

Anthony *et al*.[9] in their study "Year one of COVID-19 pandemic: Effect of lockdown and unlock phases on cataract surgery at a multi-tier ophthalmology network" disclosed that the cataract surgeries performed decreased to 5.6% (839/14,994) of pre-COVID-19 volumes during the lockdown phase. There was a gradual recovery of the cataract surgeries performed to 86.7% of pre-COVID-19 volumes by May 2020 and exceeded by 17.9% by September 2020. There was a decrease in the number of women who underwent cataract surgery during the lockdown phase (49.11%) compared to the pre-COVID-19 (52.59%) or unlock phase (52.29%, $P < 0.001$). Patients operated on during the lockdown phase were younger when compared to other groups ($P < 0.001$). The mean LogMAR presenting visual acuity at the time of surgery was worse in patients operated on during the lockdown phase (1.84 ± 1.16) as compared to pre-COVID-19 (1.39 ± 1.05) and unlock phases (1.51 ± 1.08, $P \leq 0.001$). The proportion of patients with total cataracts was higher during the lockdown and unlock phases compared to the pre-COVID-19 phase ($P < 0.001$). They concluded that the first year of the COVID-19 pandemic saw a drastic reduction in the surgical

volume in the lockdown phase, which recovered quickly during the unlock period.

When Ting *et al.*[10] in their study "The impact of COVID-19 pandemic on ophthalmology services: are we ready for the aftermath?" compared the statistics between June 2019 (pre-COVID-19) and June 2020 (during the COVID-19 pandemic), they observed a substantial 63% and 67% reduction in the outpatient and surgical activities, respectively. In addition, there was a significant ~1800% increase in the number of virtual- or tele-consultation visits ($P < 0.0001$), highlighting the real-world utility and patient receptivity of telemedicine during the COVID-19 period. From March 18, 2020, to July 1, 2020 (a 15-week period), there was a significant increase in the 18-week referral-to-treatment (RTT) breaches/waiting list in outpatient review (by 75%) and surgeries (by 471%). Cataract surgery (53%) formed the majority of the surgical backlog, followed by Capsulotomy with Neodymium Yttrium Aluminimum Garnet (Nd:YAG) laser (24%) and oculoplastic surgeries (8%).

CONCLUSION

In conclusion, the authors expressed the impact of the COVID-19 pandemic on cataract surgeries at a tertiary care ophthalmology center in India. There was a complete standstill of elective cataract surgeries during the nationwide lockdown during the first wave. However, as soon as the transportation began and elective cataract services resumed, there has been a huge response from the patients' end. With the positive efforts from the policymakers and our institution, the statistical supremacy in the post-COVID duration was evident compared to the pre-COVID times regarding cataract surgery. Even the emergency cataract surgeries toll was also on a rise. The other reviewed publications mentioned above also support the fact of the increasing trend of cataract surgery statistics in the post-COVID period. So, it is right to say that the world of ophthalmology has experienced a "post-pandemic boom" with respect to cataract surgeries.

Ethical policy and institutional review board statement

Retrospective study, retrospective data.

Patient declaration of consent statement

Retrospective data were collected.

List of abbreviations

Abbreviation	Definition
AIOS	All India Ophthalmological Society
ICD-10	International Classification of Diseases, Tenth Revision
OPD	Outpatient department
PCR	Polymerase chain reaction
LIG	Lens-induced glaucoma
ISBCS	Immediately sequential bilateral cataract surgery

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Comparing the prevalence of lattice degeneration and requirement of barrage laser in different grades of myopia

ABSTRACT

Purpose: One of the common forms of retinal degeneration noted in myopic individuals is the lattice degeneration, which may progress to rhegmatogenous retinal detachment. In clinical practice, patients with moderate and high myopia undergo frequent evaluation of peripheral retinal degeneration and prophylactic barrage laser treatment is performed when indicated. However, patients with mild myopia are not routinely screened for degeneration. **Aims:** To compare the prevalence of peripheral retinal degeneration and to also compare the presence of sight-threatening degeneration requiring barrage laser treatment in patients with different degrees of myopia. **Materials and Methods:** In this study, we enrolled a total of 3,101 eyes of patients aged >5 years with myopia who visited the ophthalmic outpatient department at Father Muller Medical College. Detailed ophthalmic examination was performed to identify lattice degeneration and evaluate the requirement of barrage laser in all myopic eyes and data was recorded. **Statistical Analysis Used:** Statistical analysis was done using Chi-square test to estimate statistical significance. **Results:** A total of 1600 people were examined and the male: female ratio was 0.76:1. The proportion of mild, moderate, severe, and pathological myopia was 37.74%, 57.75%, 1.12%, and 0.68%, respectively. Mild myopia had a statistically similar requirement for barrage laser as compared with that of moderate, high, or pathological myopia. **Conclusions:** The results indicated that mild and moderate myopia cases should also be examined for lattice degeneration features as these cases sometimes might require barrage treatment.

Keywords: Barrage laser, lattice degeneration, myopia

INTRODUCTION

Myopia or near-sightedness is a refractive error caused by excessive axial elongation. Myopia has become a potential vision-threatening problem globally and has shown a steep increase in its prevalence in the past few decades.[1] Meta-analysis conducted in 2015 by Pan *et al.*[2] on Asian population showed the prevalence of myopia to be 24.2% in children younger than 20 years and approximately 30% in adults older than 40 years. The worldwide increase in the prevalence of myopia from 22.9% in 2000 to 28.3% in 2010 is evident and is further estimated to increase to 49.8% by 2050.[3]

The continuous axial growth in myopic individuals causes stretching of outer coats and various other degenerative changes in the retina, choroid, and vitreous, making patients prone to developing peripheral retinal degenerations.

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LD is considered to be a precursor of retinal detachment and occurs in 8%–10% of the general population,[4] and exists for almost 33%[5] of the patients with myopia. The exact etiology of this condition is unknown but is thought to be due to peripheral retinal capillary dropout and resultant retinal ischemia. Larger vessels become sclerotic and their lumen is filled with extracellular glial tissues exhibiting a fibrotic appearance and thus presents as a linear trail of fibrosed vessels with atrophied retina in a "lattice" pattern.[6]

The main concern with LD is the occurrence of complications like rhegmatogenous retinal detachment. The barrage laser

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is an argon laser treatment, which is performed to seal the degenerated retina by scarring to prevent retinal tears and sometimes performed prophylactically around a hole or tear associated with LD in an eye at risk of developing retinal detachment.[7]

The objective of this present study was to identify the proportion of patients with different degrees of myopia and to compare the prevalence of peripheral retinal degenerations in them. We also compared the presence of sight-threatening degenerations requiring barrage laser in patients with different degrees of myopia.

MATERIALS AND METHODS

This study was conducted among myopic patients who visited an ophthalmic center at Father Muller Medical College, Mangalore, India. A total of 3101 myopic eyes of patients of more than 5 years of age were examined between April 2020 and April 2022. The study was approved by the institutional ethics committee, and the procedures were in accordance with the tenets of the Declaration of Helsinki. Written informed consent was obtained from all the patients or their guardians for their inclusion in the study.

Individuals with a history of any previous ocular disorders, ocular trauma, or surgery including refractive surgeries and those with any hereditary systemic disorders like Stickler syndrome, Down's syndrome, Marfan's syndrome, and those with a history of prolonged intake of systemic drugs like steroids or sulfonamides or those having diabetes mellitus, which can cause acquired myopia due to changes in the refractive index of the lens, were all excluded.

Best-corrected visual acuity measurement using Snellen's chart, noncycloplegic autorefraction, and subjective cycloplegic refraction was conducted. Cycloplegia was induced with 1% cyclopentolate hydrochloride eye drops (cyclopent eye drops, Sun Pharmaceutical Ltd). One drop was administered every 15 min and repeated three times (Havener's recommended dose), and retinoscopy was performed using HEINE streak retinoscope 60 min after the last dose. Spherical equivalent refraction (SER) was calculated as the sum of the spherical power and half of the cylindrical power. Myopia was divided into four categories, mild, moderate, high, and pathological myopia. Mild myopia was defined as spherical equivalent (SE) of < -0.50 D to -3.00 D, moderate myopia as -3.00 D to -5.00 D, high myopia as -5.00 D to -10.00 D, and pathological myopia as < -10.00 D and above.[3,8]

All patients underwent a detailed slit-lamp examination for the assessment of anterior segment. After pupil dilation, central fundus examination was done using 90 D lens (VOLK manufactures). Peripheral retinal changes were examined by scleral indentation using a HEINE binocular indirect ophthalmoscopy (BIO) by two trained vitreoretinal surgeons. The surgeons examining the retina were not informed about the degree of myopia and the retinal findings were documented. Standardized findings considered were LD, white without pressure (WWOP) and white with pressure (WWP), snail-track degenerations, peripheral chorioretinal atrophic changes, retinal holes/tears, and detachment. The findings of both the eyes were documented.

The decision to treat the lattice degeneration was taken by the vitreoretinal specialists based on a set of indications that were mutually agreed upon and were as follows:

1. Patient characteristics: One-eyed patients, patients with a history of retinal detachment in the other eye
2. Eye characteristics: Lattice degenerations with atrophic holes, absence of posterior vitreous detachment.

Statistical analysis

The data were entered in Microsoft Office Excel 2007 (Microsoft Corp., USA) and Statistical Package for Social Sciences (SPSS) version 21 (IBM Corp., NY, USA) was used for the analysis. Statistical significance was assessed using the Chi-square test and $P < 0.05$ was considered statistically significant.

RESULTS

A total of 1600 patients and 3101 myopic eyes were included in the study. Of them, 43.43% were males and 56.56% were females. Most of the males were in the age group of 11–20 years (14.50%), followed by the 21–30 years age group (9.31%). Among the females, 22.37% belonged to the 11–20 years and 15.18% belonged to the 21–30 years age group. Thus, a total of 61.37% of the study population belonged to the age group of 11–30 years. Less than 1% of the participants were above 80 years of age [Table 1].

Among the 3101 eyes that were examined, 37.74% had mild myopia, 57.75% had moderate myopia, and 1.80% had severe to pathological myopia [Table 2].

A total of 13.89% of the total eyes had retinal damage, 9.57% had LD, and 3.25% had pigmentary changes and holes [Table 3].

The proportion of LD was similar among the mild, moderate, and pathological myopia. The proportion of cases where LD was present and the requirement of the barrage was

Table 1: Age and gender distribution of the study population

	Males *n* (%)	Females *n* (%)
Age group		
<10 years	33 (2.06%)	33 (2.06%)
11-20 years	232 (14.50%)	358 (22.37%)
21-30 years	149 (9.31%)	243 (15.18%)
31-40 years	83 (5.18%)	91 (5.68%)
41-50 years	51 (3.18%)	48 (3%)
51-60 years	46 (2.87%)	49 (3.06%)
61-70 years	72 (4.50%)	61 (3.81%)
71-80 years	24 (1.50%)	20 (1.25%)
81-90 years	5 (0.31%)	2 (0.12%)
Total	695 (43.43%)	905 (56.56%)

Table 2: Distribution of patients on the basis of degree of myopia

Degree of myopia	No. of eyes *n* (%)
Mild myopia	1195 (37.34%)
Moderate myopia	1848 (57.75%)
High myopia	36 (1.12%)
Pathological myopia	22 (0.68%)
Total	3101 (96.90%)

Table 3: Retinal degenerative changes in the study population

Retinal degenerative changes	No. of eyes *n* (%)
Lattice degeneration	297 (9.57%)
Pigmentary changes and holes	101 (3.25%)
Rhegmatogenous degeneration with retinal holes	33 (1.06%)
Total	431 (13.89%)

warranted was 2.01% in mild myopia, 2.27% in moderate myopia, and 4.54% in pathological myopia. The proportion of cases with LD which required barrage in mild and moderate myopia put together was not statistically different from the number of cases with high and pathological myopia. Approximately 7% of the cases, which had mild and moderate myopia did not require barrage despite being diagnosed to have LD. Approximately 4.54% of pathological myopias had LD but barrage was not required [Table 4].

There was no difference in the requirement of barrage laser treatment in different degrees of myopia, which meant that mild myopia has a statistically similar requirement of barrage as compared with that of moderate, high, or pathological myopia [Table 5].

DISCUSSION

Myopia, commonly referred to as short-sightedness, is a form of refractive error and is a very common cause of visual disability worldwide.[9] LD is an important clinically recognized vitreoretinal abnormality that is noticed in myopia.[10] Based on a prospective study among a myopic population in India, the prevalence of retinal degeneration was found to be 42% and LD was the most common type.[11] However, not all LD of the retina require intervention.[12] The prevalence of LD is generally thought to be common in high myopia and hence cases of mild and moderate myopia are not routinely screened for peripheral retinal degenerations in clinical practice.

In our study, the proportion of myopic cases with LD was 297 (9.57%). The prevalence of LD is greater in myopic eyes and accounts for 33% when compared with the general population where it is around 6%–10%.[13] Karlin and Curtin[14] reported an increased incidence of LD with increasing axial length and accounted for 6.1% of the total number of cases.[14] The incidence of LD was 13.2% in eyes with axial length greater than 24 mm according to a study conducted by Pierro *et al*.[15] In another study conducted by Celorio and Pruett,[13] the incidence of lattice degeneration was found to be 24.1% in eyes with greater than 6 diopters of myopia.

Moustafa[16] stated that prophylactic laser barrage treatment significantly reduces the incidence of retinal detachment in high myopia. Increased risk of retinal complications is usually seen in patients with high myopia and the complications usually include retinal detachment, posterior staphyloma, chorioretinal atrophy, retinal pigment epithelial atrophy, and macular hemorrhage. Among the peripheral retinal degenerations, LD is the most common and can predispose patients to rhegmatogenous retinal detachment. In the present study, 9.57% of myopic patients presented with LD. Among them, only 2.16% required barrage laser as treatment.

Zhang[17] found that patients with high myopia had the maximum frequency of retinal changes in the form of LD. Ophthalmologists tend to examine the high myopes more extensively when compared with those with mild and moderate myopia. Hence, some patients are deprived of a chance of early prophylactic barrage laser. In the present study, there was no difference in the requirement of barrage laser among different degrees of myopia. This suggests that mild and moderate myopia cases have a similar requirement for barrage laser as compared with that of high or pathological myopia. The study having been conducted on a significant study population has the potential to change the current practice pattern with regard to screening myopic patients to prevent vision-threatening complications. In the background of the rising number of myopic patients, larger studies are needed to implement routine screening of all myopes as a practice pattern.

CONCLUSION

Our study showed that the presence of sight-threatening peripheral retinal degenerations in mild and moderate myopia

Table 4: Presence of lattice degeneration and requirement for a barrage laser in different degrees of myopia

Degree of myopia (BE)	Total myopia cases	Total lattice cases	Lattice + barrage	Lattice but no barrage	No lattice but barrage
Mild	1195	114 (9.54%)	24 (2.01%)	90 (7.53%)	74 (6.19%)
Moderate	1848	173 (9.36%)	42 (2.27%)	131 (7.08%)	84 (4.54%)
High	36	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Pathological	22	2 (9.09%)	1 (4.54%)	1 (4.54%)	2 (9.09%)

Table 5: Differences in requirement of barrage laser in different degrees of myopia

Degree of myopia (BE)	Total myopia cases	Barrage laser done	No requirement of barrage laser	Chi-square value	*P*
Mild	1195	98	1097	2.4469	0.2942
Moderate	1848	126	1722		
High + pathological	58	3	55		

cases are similar to that of patients with high myopia and hence screening of all myopic patients for peripheral retinal degenerations is prudent. The study also shows that there is no difference in the requirement of barrage laser in different degrees of myopia, which means that mild and moderate myopia has a statistically similar requirement of barrage as compared with that of high or pathological myopia.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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There are no conflicts of interest.

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When the eye "met" the eye: A peek into the history of corneal transplantation



Figure 1: Dr. Eduard Zirm, performing penetrating keratoplasty surgery (1905) in his operating theatre. https://europepmc.org/article/med/24391366

Corneal transplantation surgery is the most successful of all organ transplants and has been a breakthrough in the history of medicine. Though the original concepts of corneal transplantation surgery date back to the times of the Greek physician Galen (130–200 AD),[1] it was an enthralling journey through centuries, filled with strange theories, adventurous experiments, and perseverance that resulted in the current status of corneal transplantation as the most successful organ transplant surgery.

The concept of corneal trephination as a part of the management of leucomatous cornea was first put forward by Erasmus Darwin in 1760.[2] In 1813, Karl Himly first suggested the replacement of opaque animal corneas with transparent corneas obtained from other animals.[3] However, it was Franz Reisinger, a student of Himly, who introduced the concept of replacing a scarred cornea with a transparent animal cornea[4] in 1824 and coined the term keratoplasty. But none of these early attempts resulted in clear corneal grafts and this was basically due to the deficient understanding of the basic sciences, drugs, physiology, immunology, antisepsis, anesthesia, and limited knowledge of microsurgical techniques. The devastating failure in corneal transplantation by many surgeons across the globe made it an "audacious dream" for more than a century.

Finally, on December 7, 1905, Czech ophthalmologist Dr. Eduard Zirm performed the first successful corneal transplantation [Figure 1], an event that was the culmination of centuries of trials and experimentation.[5]

This remarkable photograph shows Dr. Eduard Zirm (1887–1948), performing penetrating keratoplasty (1905) in his operating room, in Olmutz near Prague. The recipient of this premiere was a 45-year-old farm worker named Alois Glogar, who had turned blind from severe alkali injury with lime while working in a chicken coop, 16 months earlier. The live donor for this surgery was a boy of 11 years, who had been blinded from penetrating eye injury to the sclera. The donor eye was enucleated and two 5-mm donor grafts were used to perform bilateral transplants. Dr. Zirm used chloroform anesthesia, preoperative miotics, overlay sutures, and adhered to strict asepsis. Though the right eye graft failed, the graft in the left eye survived and the patient's

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visual acuity improved from counting fingers to 6/36 at six months.[5]

Following this breakthrough event, the following key concepts for successful transplantation were elucidated by Zirm: exclusive use of human corneas, preferably from young and healthy donors, use of von Hippel trephine for trephination of the tissue, deep anesthesia, strict asepsis, overlay sutures, use of an anterior chamber maintainer, avoidance of touching of the corneal tissue, and placement of the graft between moist gauze for protection prior to transplantation.

In 1914, Anton Elschnig developed the technique of partial penetrating keratoplasty using the von Hippel trephine.[6] The use of cadaver corneas was first suggested by the Russian ophthalmologist Vladimir Filatov.[7] This idea was further developed by Richard Townley Paton, who established the first eye bank in 1944 in New York City.[8] Ramon Castroviejo popularized the use of direct sutures and invented several surgical instruments for corneal transplantation.[9]

The latter half of the 20th century witnessed significant refinements in the instrumentation of corneal transplantation surgery including microsurgical instruments, improved trephines, viscoelastic substances, surgical microscopes, and suture materials, along with the development of corticosteroids, antibiotics, and better understanding of ocular immunology.

The enthralling story of corneal transplantations continued with the idea of posterior lamellar transplants put forward by Jose I. Barraquer[10] and the scleral–limbal approach in rabbit corneas by Dr. Ko (1993).[11] Gerrit R. J. Melles performed this scleral–limbal procedure in humans and named it as posterior lamellar keratoplasty.[12] Mark Terry made further refinements in this procedure and renamed it as deep lamellar endothelial keratoplasty in 2003.[13] Further advancements in instrumentation led to the introduction of Descemet-stripping endothelial keratoplasty, Descemet-stripping automated endothelial keratoplasty with the use of the microkeratome and Descemet membrane endothelial keratoplasty.

Recent developments in the field of corneal transplantation include the introduction of artificial or bioengineered corneas, the use of corneal endothelial cells as a substitute for transplantation, and the use of femtosecond laser.

The fascinating story of the evolution of corneal transplantation surgery packed with wonderful ideas, trials, tribulations, perseverance, and hard work of pioneers has saved millions of eyes and continues to inspire and amaze us.

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Case Report

Recurrent posterior capsule opacification in an adult

ABSTRACT

A 59-year-old male presented with diminished vision in the right eye (OD) after undergoing cataract surgery 4 years back. One year later, he developed posterior capsular opacification, for which laser capsulotomy was done. He had good vision since then. His vision deteriorated again for the last 6 months. On examination, OD showed opacification of posterior capsule within the area of laser capsulotomy. A repeat laser capsulotomy was done in OD. Vision was 6/6 (OD) on the follow-up 2 weeks later.

Keywords: Complications of cataract surgery, laser capsulotomy, recurrent posterior capsule opacification

INTRODUCTION

Posterior capsule opacification (PCO) is the most common late complication after cataract surgery. Laser capsulotomy is an effective, quick, and noninvasive procedure for the treatment of PCO. Recurrence of PCO is very rare in adults. With the latest technology and advanced surgical options, expectations of surgeons and patients are on the high. The need for repeated treatment after undergoing modern-day cataract surgery is troublesome. Laser capsulotomy is not without complications either. Damage to intraocular lens (IOL), retinal detachment, raised intraocular complications, and cystoid macular edema can occur. Elimination of PCO still remains a major hurdle. Unknown factors leading to recurrent proliferation of lens epithelial cells and formation of "secondary cataract" need to be unfolded.

CASE REPORT

A 59-year-old male, with no systemic illness, presented to our outpatient department, with complaints of painless progressive decrease of vision in both eyes (OU) for 3 months. He had undergone an uneventful phacoemulsification in the right eye (OD) 4 years ago. His immediate postoperative vision was 6/6. A year later, he had presented with defective vision in OD with a best-corrected visual acuity of 6/18 and pearly PCO. A laser capsulotomy was performed then. Vision improved to 6/6 again.

On current examination, uncorrected visual acuity (UCVA) in OD was 6/18 and was not improving with glasses, and UCVA in the left eye (OS) was 5/60 improving to 6/12 with glass. Anterior-segment examination revealed a single-piece IOL in the bag with pearly-type PCO in OD. However, he gave a previous history of laser capsulotomy in OD 2 years back. We noted that the Elschnig pearls were present even within the circular opening of old YAG capsulotomy [Figures 1 and 2]. OS had nuclear sclerosis with posterior subcapsular cataract. Fundus examination was normal in both eyes. A laser capsulotomy was repeated again [Figure 3]. On follow-up at 2 weeks later, his UCVA improved to 6/6.

DISCUSSION

PCO occurs months or years after cataract surgery. A variety of factors such as ocular or systemic conditions,

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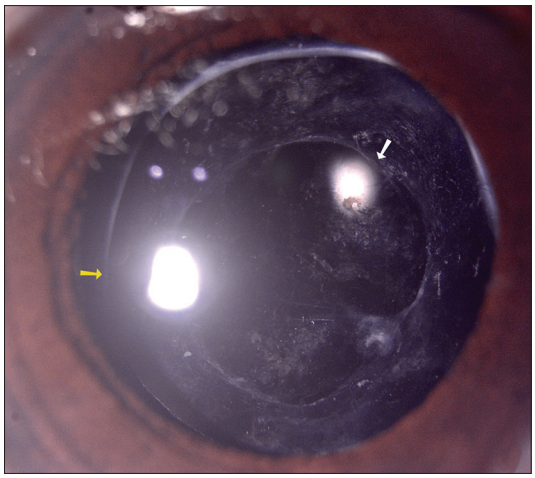


Figure 1: Slit lamp image under diffuse light showing the posterior capsule opacification

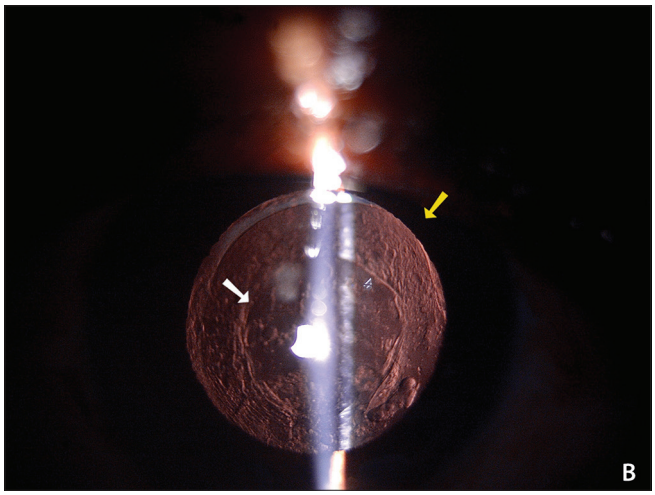


Figure 2: Retroillumination image. Yellow arrow – capsulorhexis margin. White arrow – previous laser capsulotomy margin

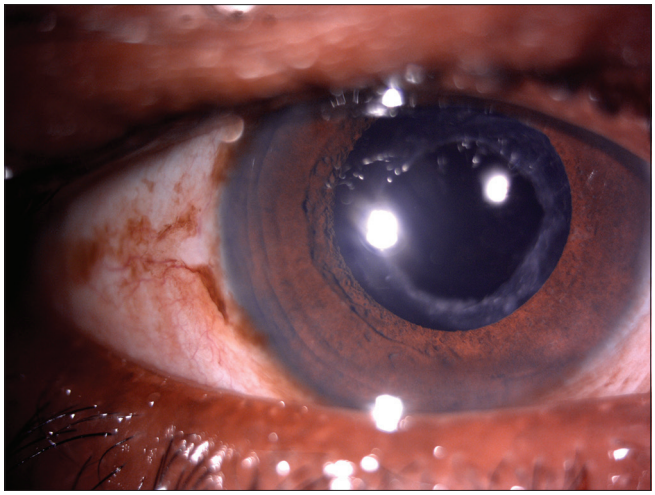


Figure 3: Slit lamp image post repeat laser capsulotomy

intraoperative factors, and type and position of the IOL affect the development of PCO. Advances in surgical techniques and introduction of a wide range of IOLs have tremendously reduced the rate of PCO, but the problem still remains.

PCO occurs due to proliferation, migration, and differentiation of residual lens epithelial cells. These cells migrate to the posterior capsule and cause obscuration of visual axis.[1] The only effective treatment of PCO is Nd:YAG laser capsulotomy; it creates a central opening in the opacified portion of posterior capsule. Visual acuity and contrast sensitivity improve after an easy outpatient procedure.

Recurrence of PCO after YAG capsulotomy is very rare, especially in adults. Roger *et al*. have reported a recurrence rate of 0.7%.[2] Literature shows that underlying systemic or ocular disorders were associated with recurrent PCO. Recurrent proliferation of lens epithelial cells without any other pathological conditions or intraoperative complications is very rare.

Recurrence can occur in postvitrectomized eyes and in patients operated for complicated cataract. Proliferation of lens epithelial cells along anterior hyaloid phase can occur in vitrectomized eyes. PCO progresses at a rapid rate in patients who underwent combined surgery or sequential pars plana vitrectomy and cataract surgery.

A curious case of visual axis opacification in a patient implanted with hydrophobic acrylic IOL was described by Kalliath *et al*.[3] The patient had undergone vitrectomy for retinal detachment. Jones *et al*. reported massive proliferation of lens epithelial remnants following Nd: YAG laser in 8 eyes.[4] All patients were found to have some retinal pathology. Rajesh *et al*. reported recurrent PCO in two patients, among whom one had intraoperative posterior capsule dehiscence.[5]

Literature shows that repeated capsulotomies were needed in patients with myotonic dystrophy. Gjertsen *et al*. reported multiple recurrences of secondary opacification in the anterior and posterior capsules in three myotonic dystrophy patients.[6] Similarly, Garrot *et al*. described multiple capsulotomies in two patients with myotonic dystrophy.[7] One patient had eight posterior capsulotomies in the two eyes, while the other had seven anterior and seven posterior capsulotomies in the two eyes. This shows the aggressiveness of proliferation of lens epithelial cells in patients with myotonic dystrophy.

In their influential 2001 study on eradication of PCO, Apple *et al*. provided valuable insight into factors leading to the progression of PCO. Six factors influencing PCO were defined: hydrodissection before phacoemulsification, in-the-bag

fixation of IOL, appropriately sized anterior capsulorhexis, use of highly compatible IOL material, optimal contact of IOL material and posterior capsule, and IOL optic geometry with square, truncated edges.[8] All these factors are taken into consideration by the industry and ophthalmologists worldwide.

Our patient had no systemic illness and no ocular pathology; surgery was uneventful. Still, there was aggressive proliferation of lens epithelial cells, which lead to recurrence of PCO within a short time.

A wide array of IOL designs and materials have been introduced and better surgical techniques have evolved in the pursuit of eliminating PCO. PCO still remains a common complication after cataract surgery. Ongoing research studies should focus on unraveling factors, leading to proliferation of lens epithelial cells after surgery. Recurrent PCO is a discouraging situation for both surgeon and the patient, especially after a meticulous workup and surgery. Apart from being a financial burden, laser capsulotomy is associated with serious complications such as retinal detachment.

CONCLUSION

Our case highlights the importance of recognizing the compounding factors in the causation of PCO. Ongoing research should focus on unraveling the triggering factors which make few people more prone to aggressive proliferation of the lens epithelial cells. Elimination of PCO needs strenuous efforts and vast research as it occurs as a part of nature's efforts to adapt to the loss of lens tissue.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Case Report

Giant orbital schwannoma with cystic degeneration in a young female managed with extended enucleation

ABSTRACT

Schwannomas are benign, slow-growing, and noninvasive tumors. They account for 1% of all orbital tumors. A 32-year-old female patient presented with a large mass and proptosis of the right eye for 4 years. On imaging, a large well-defined mass, heterogeneous mass of the right orbit with the evidence of cystic degeneration, was present. On incisional biopsy, fusiform cells arranged in intertwine bundles with characteristic Verocay bodies (Antoni A) and multiple cystic regions (Antoni B patterns) were found. S-100 was found positive on IHC, and a diagnosis of schwannoma was made. Cystic degeneration in orbital schwannoma has also been reported but very rarely.

Keywords: Cystic degeneration, extended enucleation, orbital schwannoma, schwannoma

INTRODUCTION

Schwannomas of the orbit account for 1% of all orbital tumors.[1] They are rare. It is a benign, slow-growing tumor of the peripheral nervous system presenting in adulthood. The cystic form of schwannoma is very rare, but reports of such changes have been documented to occur in the brainstem, intracranial nerves, and the adrenal region.[2] Cystic degeneration in orbital schwannoma has also been reported, but very rarely.

CASE REPORT

A 32-year-old female patient presented with a large mass protruding from her right eye for the past 4 years. There was a history of progressive loss of vision for the same duration.

On general examination, she was alert, conscious, and cooperative with stable vitals. On ophthalmological examination, there was a large mass causing stretching of eyelids with widening of the palpebral aperture on the right side [Figure 1a]. The globe was distorted, the cornea and conjunctiva were keratinized. There was associated upper and lower eyelid fullness along with ulceration in the medial aspect of the upper eyelid. The mass was firm-to-hard inconsistency, and there was no pulsation or bruit. The other eye was within normal limits.

Radiological investigation revealed a large well-defined mass with heterogeneous density occupying nearly the whole of the right orbit with the evidence of cystic degeneration [Figure 1b]. The globe was totally distorted, and no extraocular muscle could be visualized separately. A provisional diagnosis of orbital schwannoma with cystic degeneration was made, and differentials included solitary fibrous tumor, angiofibroma, nonossifying granuloma, and giant orbital dermoid.

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An incision biopsy was performed, and it came out to be positive for schwannoma. The patient underwent extended enucleation with complete excision of the schwannoma. Histopathology showed schwannoma with cystic degeneration [Figure 2a-d].

DISCUSSION

Schwannomas are benign, slow-growing, and non-invasive tumors. First described Verocay in 1908, these tumors are also known as neurilemmomas or neuromas of Verocay.[3] They are typically encapsulated and arise from the myelinating cells of peripheral nerves. In orbit, these comprise a minuscule group, forming 1%–8% of all orbital tumors.[4]

Orbital schwannomas generally appear between the second and fifth decades but may rarely occur in the pediatric age group.[4,5] There is no gender predilection. These tumors can arise from branches of oculomotor, trochlear, trigeminal, and abducens nerves, as well as from sympathetic and parasympathetic fibers. Sensory fibers are more affected than motor fibers. Superior orbit is more commonly involved.[6] However, the exact origin of these tumors often stays elusive owing to the complex anatomy of the orbit.

When small, schwannomas are usually asymptomatic. As the tumor enlarges, the patient presents with slowly progressive proptosis and/or globe dystopia. There may also be restriction of eye movements which further lead to diplopia and strabismus. Diminution of vision can also be a presenting feature owing to hyperopia induced by globe indentation or optic atrophy secondary to optic nerve compression by the tumor. In long-standing cases, the patient may have an exophytic mass. Erosion of bony structures, though not usually seen, has been reported.[5] Our patient presented to us with a large exophytic mass of 8 cm × 6.8 cm, which had progressively increased in size over a year-long period and was associated with loss of vision.

The definite diagnosis of schwannoma is made on the basis of histopathological examination. There are two patterns of the said tumor: the Antoni type A schwannoma, which is characterized by compactly arranged spindle cells with abundant eosinophilic cytoplasm and long oval nuclei with long thin axes parallel to one another with poor cytoplasmic margins, and the Antoni type B schwannoma, which is characterized by haphazardly distributed cells with distinct cytoplasmic margins.[7] In 1910, Verocay first described a structure consisting of a stacked arrangement of two rows of elongated palisading nuclei that alternates with acellular zones made up of cytoplasmic processes of the Schwann cells. This structure was termed Verocay's body and is considered diagnostic of a schwannoma. Akin to our case, schwannoma may also rarely undergo cystic degeneration.[8]

Complete surgical resection is the mainstay treatment of schwannoma.[6] Surgical approaches include superior, anterior, and inferior or lateral orbitotomy, depending on the site of the lesion.[9] As schwannomas arise from the Schwann cells, they are usually present on the periphery of the involved nerve without involving the axon. Therefore, it is possible to simply strip the tumor away from the nerve.[10]

When the tumor mass involves important structures such as the middle ear, skull base, or facial nerve, subtotal resection can be done.[11] If the mass is large and involves the whole of the orbit, as in our case, orbital exenteration followed by rehabilitation can be performed. The patient should be counseled for the need

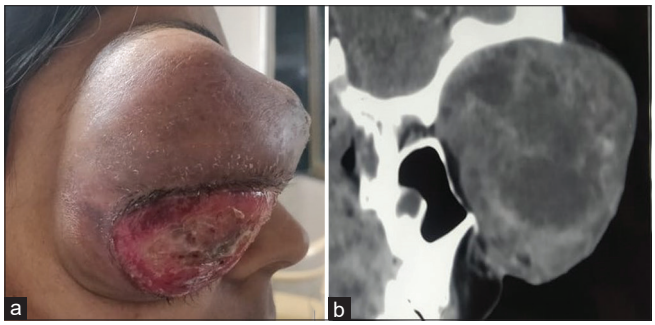


Figure 1: (a) Clinical picture of the right orbit with massive proptosis due to a large mass causing stretching of eyelids with widening of the palpebral aperture. (b) Computed tomography scan of the orbits with sagittal cuts showing a well-defined heterogeneous intraconal mass in the right orbit showing areas of cystic degeneration

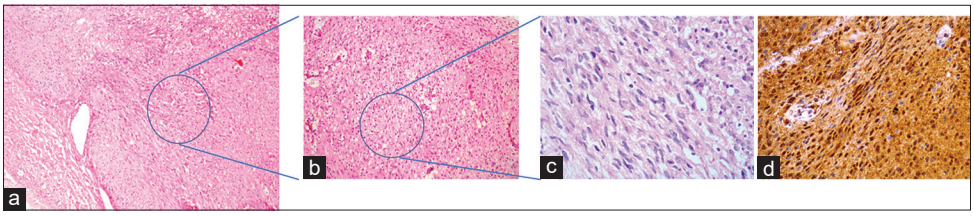


Figure 2: (a and b) Light microscopy shows characteristic Verocay bodies (Antoni A) and multiple cystic regions (Antoni B patterns) (H and E, ×200). (c) Higher magnification demonstrates fusiform cells arranged in intertwine bundles (H and E, ×400). (d) Immunohistochemical stain shows S-100 positivity in schwannoma

for long-term follow-up required to screen for any recurrence in future, thus enabling early intervention for the same.

In conclusion, preoperative diagnosis of orbital schwannoma is difficult because of its varied presentation and location in the orbit. Orbital schwannomas should be considered in the differential diagnosis of slow-growing orbital masses. Timely assessment of orbital tumors by computed tomography or magnetic resonance imaging and prompt intervention is warranted to prevent severe complications from developing.

Declaration of patient consent

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Conflicts of interest

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Case Report

360° like iris nodules in ocular tuberculosis

ABSTRACT

The case of a young male with the uniocular presentation of iris nodules of tubercular etiology is described. Interestingly, this patient had 360 like iris nodules both at the surface and pupillary border which resolved within 2 weeks of starting the anti-tubercular treatment.

Keywords: Anti-tubercular treatment, iris nodules, tuberculosis

INTRODUCTION

Ocular tuberculosis has a varied manifestation and association of iris nodules with tuberculosis is known. We describe here a case of almost 360° like presentation of iris nodules in a young male, who when treated with anti-tubercular treatment (ATT) showed an absolute response in terms of resolution.

CASE REPORT

A 17-year-old male patient was referred for complaints of redness in the right eye over 14 days. His best-corrected visual acuity (BCVA) in both eyes (BE) was 20/20. Right eye anterior segment showed the presence of iris nodules both on the surface and at the pupillary border [Figure 1] along with the presence of multiple nonpigmented Keratic precipitates (KP) on endothelium, fibrin, and 3 + cells in the anterior chamber, in the presence of a clear crystalline lens. Right eye fundus and left eye ocular examination were unremarkable. At the time of presentation, the patient was on topical prednisolone acetate 1% six times per day. He denied the history of any fever, lethargy, weight loss, and any such ocular episode in either eye. The preliminary diagnostic impression was RE Acute granulomatous anterior uveitis with suspected etiology of tuberculosis vs sarcoidosis. The patient was requested to get the blood investigations done. Meanwhile, right eye topical prednisolone acetate 1% was made one hourly and three times per day of cycloplegic; atropine sulfate 1% ophthalmic solution was added. On follow-up after 1 week, the iris nodules persisted; however, fibrin had started to show the signs of resolution with notable iris pigments on the anterior lens capsule [Figure 2]. All the blood investigations were unremarkable except for the Mantoux skin test which showed 30 mm induration after 48 hours and Chest X-ray showed the presence of two suspicious areas of calcification. Hence, a presumptive diagnosis of RE acute granulomatous anterior uveitis of tubercular etiology was made, and the patient was sent to a pulmonologist to initiate a therapeutic trial of ATT.

After 2 weeks of initiation of ATT, his BE BCVA was 20/20, and complete resolution of KP, fibrin, and iris nodules was noted [Figure 3]. The patient was then advised to continue the ATT for 6 months and his topical steroids were tapered and cycloplegics were stopped.

Outcome and follow-up

At the last follow-up, 18 months from presentation, the patient had maintained BCVA of 20/20 N6 in BE with no signs of recurrence of intraocular inflammation.

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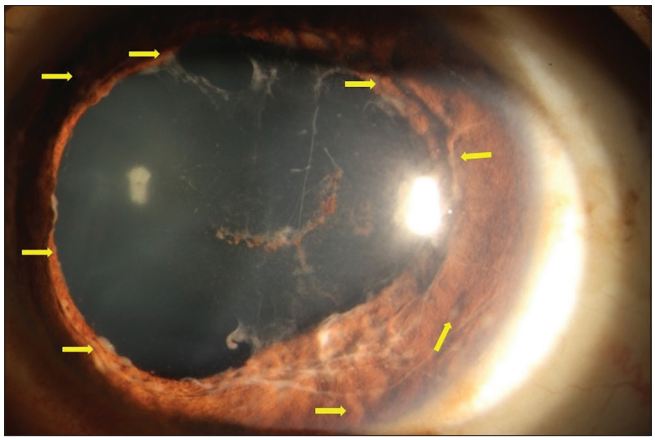


Figure 1: Slit-lamp photograph showing the presence of 360° like iris nodules at the pupillary border and at the surface of iris along with fibrin

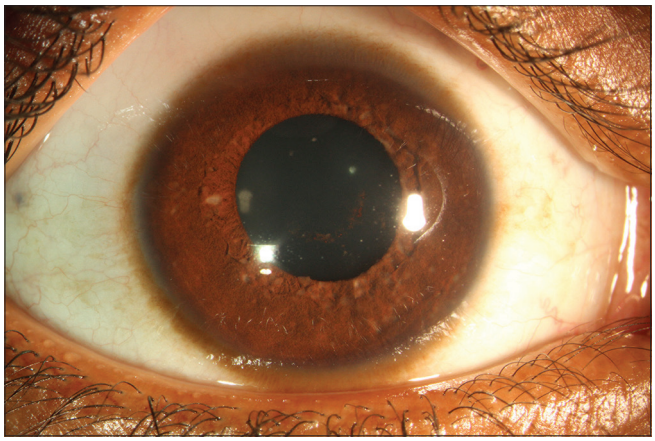


Figure 2: Slit-lamp photograph showing the persisting iris nodules and resolution of fibrin after initiation of topical steroids

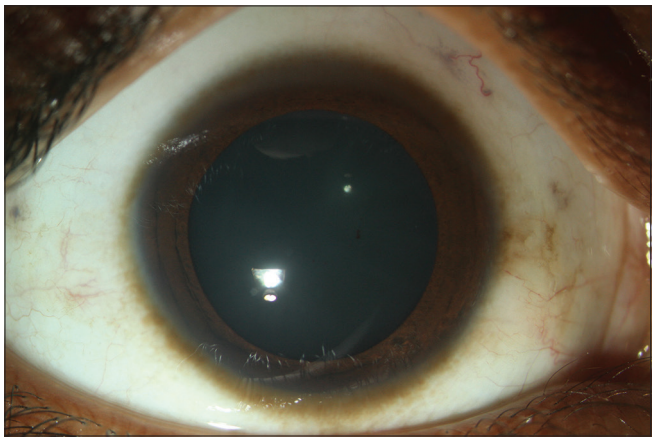


Figure 3: Slit-lamp photograph showing the complete resolution of iris nodules after initiation of anti-tubercular treatment

DISCUSSION

Uveitis is the most common mode of presentation in ocular tuberculosis which could present as either anterior, intermediate, posterior, or panuveitis. Iris nodule is a common entity in uveitis seen both in infectious and non-infectious etiologies.[1-9] The non-infectius causes are mostly sarcoidosis and Vogt-Koyanagi-Harada disease which generally have a bilateral presentation.[3,4,9] However, the infective associations alluded in literature are both bacterial and fungal which have a unilateral presentation and responds poorly to topical steroids. We too had the similar experience when our patient responded poorly to topical steroids initially and showed marked improvement in terms of resolution of intraocular inflammation after initiation of ATT. Rosen *et al*. in 1990 described the iris nodules in one of their patients wherein they made a presumptive diagnosis of tuberculosis after seeing 22 mm of Mantoux induration and started a therapeutic trial of ATT.[6] In their case as well, the iris nodules along with the anterior uveitis resolved only after initiation of ATT. Such presentation of 360° like iris affection in ocular tuberculosis warrants initiation of ATT owing to their poor response to only topical steroids.

Learning points

1. Iris nodules are seen both in infectious and non-infectious conditions.
2. Iris nodules in ocular tuberculosis responds poorly to topical steroids and warrants ATT.
3. Iris nodules of tubercular etiology are seen both at stromal surface of iris and at pupillary border.

Declaration of patient consent

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Conflicts of interest

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Case Report

Epiphora: A case of a weeping bleb

ABSTRACT

An 82-year-old female with both eyes glaucoma underwent trabeculectomy 10 years back, presented with continuous watering in the left eye for 1 week. Her visual acuity in the left eye was counting fingers at 2 m. On examination, cystic bleb in the superior quadrant with positive Seidel test was seen. Intraocular pressure was 2 mmHg. Fundus evaluation showed kissing choroids. The cause for this epiphora was found due to a late leaking bleb, and this was revised surgically. It is imperative to educate patients with cystic bleb about this kind of symptom and seek medical help immediately to avoid dreaded complications.

Keywords: Bleb leak, epiphora, hypotony, trabeculectomy

INTRODUCTION

Filtration surgery to control intraocular pressure (IOP) is well-established, safe, and effective and remains the gold-standard surgical procedure for the management of glaucoma.[1] Although the outcome of the surgery has been greatly improved over a period with the adjunctive usage of antimetabolites such as mitomycin C and 5-fluorouracil, the incidence of late-onset bleb leaks also increased along with other complications.[2] The use of antimetabolites and fornix-based incisions are notable risk factors for bleb leak.[3] Bleb leak resulting in hypotony is reported in 11%–17.6% of cases; however, most occur soon after surgery,[4] while that of a late-onset bleb leak in thin cystic and avascular blebs is 5.2%–6%.[5] Late-onset bleb leaks occur from 3 months to years after surgery; the mean time reported was 27.9 months.[6]

CASE REPORT

An 82-year-old female with a known case of glaucoma on antiglaucoma medications (AGMs) presented with continuous watering in the left eye for 1 week. She had undergone trabeculectomy in both eyes 10 years back elsewhere with no surgical details or about the use of adjunctive antimetabolites. She had visited the hospital multiple times earlier with symptoms of watering and itching which was due to allergy to various antiglaucoma medications. She was on antiglaucoma medication, which included eye drop travoprost 0.004% (Awarene PF) once daily for both eyes and eye drop betaxolol 0.5% (Iobet) twice daily for the right eye.

She presented with sudden onset of watering in the left eye for 1 week which was clear fluid and continuous in nature followed by diminution of vision 5 days later. On examination, visual acuity in the left eye was counting fingers at 2 m. Slit-lamp examination in the left eye revealed cystic bleb in the superior quadrant with positive Seidel's test, shallow anterior chamber (Van Herick Grade 2), and posterior chamber intraocular lens [Figures 1 and 2]. On applanation tonometry, IOP was 2 mmHg in the left eye. Fundus examination showed 0.8 cup disc ratio with kissing choroidals.

The cause for epiphora was attributed to the late-onset leaking bleb for which a surgical revision was done.

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A fornix-based conjunctiva-tenon flap was dissected just behind the leaking bleb, and the flap was undermined. Debridement and then excision of the cystic and leaking conjunctiva was done. A partial-thickness quadrangular donor scleral flap was placed over the thinned sclera and anchored with four 10-0 nylon sutures. The conjunctiva was advanced to close at the limbus using two 10-0 nylon sutures. One week later, best-corrected visual acuity was 6/18, and IOP was 22 mmHg, with well-formed anterior chamber and complete resolution of choroidal detachment [Figure 3]. AGM was restarted, and at the last follow-up of 3 months, the patient is doing well with well-controlled IOP and diffuse bleb.

DISCUSSION

A leaking filtration bleb is a common complication of trabeculectomy that can occur days, months, or years after the initial surgery. The possible mechanism for bleb leak is a higher chance of aqueous oozing through the unhealed epithelial defect that can eventually deteriorate into an obvious point leakage.[7]

The common signs of bleb leakage include a newly tearing eye, decrease in vision, redness, or a drop in IOP from baseline. If a patient with cystic bleb presents with watering, it is important to suspect a bleb leak and perform a Seidel test at the slit-lamp to confirm. Complications of leaking bleb include hypotony, shallow or flat anterior chamber, hypotony maculopathy, choroidal detachment, cataract formation, epithelial downgrowth, chronic inflammation, and filtration bleb failure.[8] The most feared potential consequences of late-onset bleb leaks are blebitis and endophthalmitis. Hence, it is important to identify bleb leaks at the earliest and manage appropriately.

Here, the patient had initial symptoms of watering which she was attributing to allergy, and she sought medical help when there was a drop in vision. Late leaking bleb diagnosis was made, and she was taken up for surgery soon, thus preventing from developing further complications such as blebitis and endophthalmitis.

In a case series by Mandal,[8] a known case of glaucoma with postglaucoma surgery presented with pain, redness, and watering and was diagnosed to have bleb infection with endophthalmitis because of bleb leak. Another case reported by Yalniz-Akkaya *et al*.[6] presented with diminution of vision in a patient with postpenetrating keratoplasty with trabeculectomy. Late-onset bleb leak was diagnosed in this case and treated.

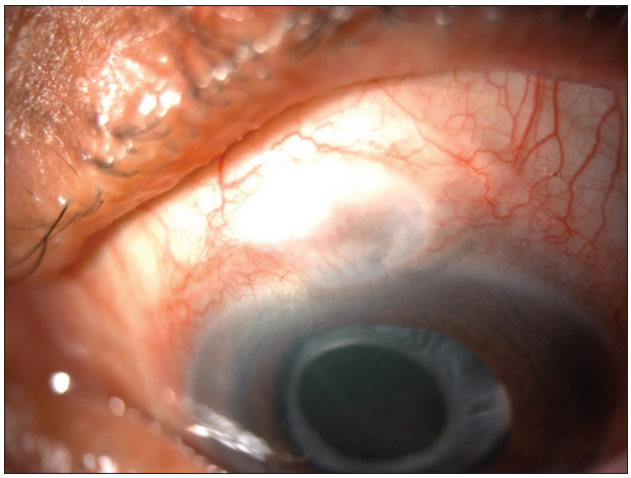


Figure 1: Cystic bleb with shallow anterior chamber

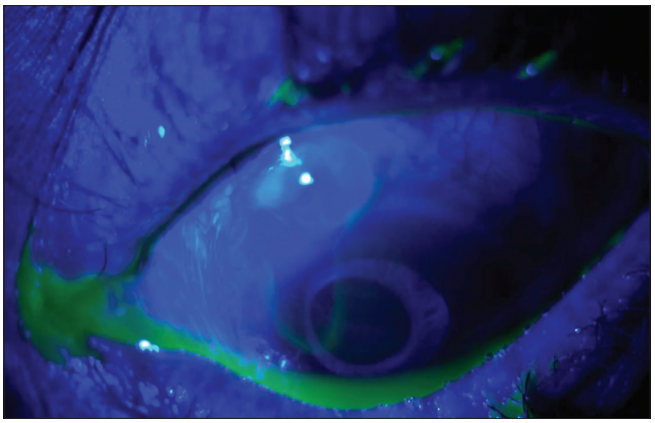


Figure 2: Positive Seidel's test viewed through cobalt blue filter

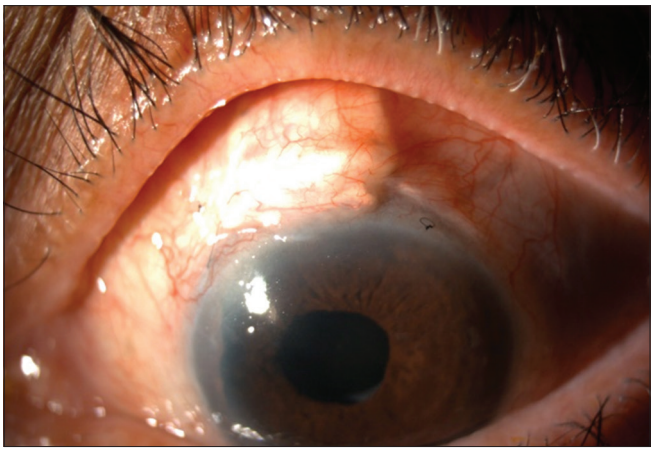


Figure 3: Postoperative picture showing bleb with scleral patch graft with well-covered conjunctiva and well-formed anterior chamber

It is vital to identify the cause of hypotony, such as bleb leak or overfiltration, to address the underlying cause. Small leaks may close with conservative treatment such as observation with or without aqueous suppressants, patching, and an ophthalmic antibiotic ointment. Other nonsurgical approaches include the placement of a bandage contact lens,

a symblepharon ring, or a Simmons shell, the administration of trichloroacetic acid, cryotherapy, argon laser therapy with or without dye enhancement, the application of fibrin glue, and the injection of autologous blood.[6]

The advancement of conjunctival tissue from the adjacent conjunctiva and/or tenon's layers and free conjunctival autografts are the two surgical techniques most frequently employed today.[9] Amniotic membrane grafts may be used in eyes with inadequate conjunctiva to advance. Autologous tenon and partial-thickness scleral patch grafts have been found adequate, safe, and effective for closing excessively draining fistulas. Bleb excision and repair of the scleral defect with a full-thickness scleral graft, followed by coverage with the advancement of a conjunctival flap or by a free conjunctival autograft, have also been useful for the treatment of leaks in association with full-thickness scleral defects.

CONCLUSION

It is imperative to educate patients with cystic bleb about the possibility of this presentation and significance of seeking immediate medical help for the same to avoid dreaded complications.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Case Report

Conjunctival capillary hemangioma - A rare case

ABSTRACT

Conjunctival capillary hemangioma is very rare, with few cases being reported in the literature. We present a case of a 60-year-old male with conjunctival capillary hemangioma, a unique case adding to the literature of uncommon vascular tumor. The patient had a mass over the left eye for 20 years, without any associated systemic diseases or cutaneous manifestations. The lesion was imaged with anterior-segment optical coherence tomography and the findings have been presented and the diagnosis was confirmed by histopathology.

Keywords: Conjunctival capillary hemangioma, hemangioma, vascular tumors

INTRODUCTION

Vascular tumors of the conjunctiva are considered rare and usually arise without any pathology. Among all these vascular tumors, capillary hemangiomas of the conjunctiva are very rare.[1] Conjunctival capillary hemangioma is a rapidly developing tumor derived from endothelial cells, which has rarely been reported in patients over 60 years old.[2] Here, we discuss development of a conjunctival hemangioma with insidious growth in a 60-year-old patient.

CASE REPORT

A 60-year-old male presented decreased vision in both eyes (left eye > right eye) with a "reddish mass" in his left eye of 20 years of duration. The patient had no pain, change in vision, size, or color of the lesion over this time period. He denied a history of eye trauma, allergy, or use of medications (including), blood thinners, and nonsteroidal anti-inflammatory drugs. The ophthalmic evaluation including dilated fundus examination was unremarkable, except for the slit lamp examination of the left eye, which revealed a 2.5 mm × 5 mm, immobile, solid conjunctival hemorrhagic lesion extending onto the cornea with well-defined borders, without feeder vessels or overlying Lissamine green stain. The tumor is demonstrated in Figure 1. Anterior-segment optical coherence tomography (AS-OCT) was done, and it revealed well-defined cystic spaces in full thickness of conjunctiva extending to superficial sclera and also showing extension to superficial one-third of the cornea as shown in Figure 2. The clinical diagnosis at that time was conjunctival varix or conjunctival hemangioma. The patient then underwent an excision biopsy. The lesion was excised completely and an amniotic membrane was placed [Figure 3]. Specimen was sent for histopathological analysis. The patient was treated with a course of topical antibiotics and steroids, and it was seen to heal well.

The conjunctival biopsy showed subepithelial proliferation of variably thin-walled ectatic vascular channels; some filled with blood, lined by a single layer of nontypical, endothelial cells [Figure 4a and b]. Sections from the scleral specimen showed dilated thin-walled vessels embedded in the stroma [Figure 5a and b]. The final pathologic diagnosis was conjunctival capillary hemangioma.

DISCUSSION

A myriad of vascular tumors can be noticed in pediatric age groups as well as in adults in both bulbar and palpebral

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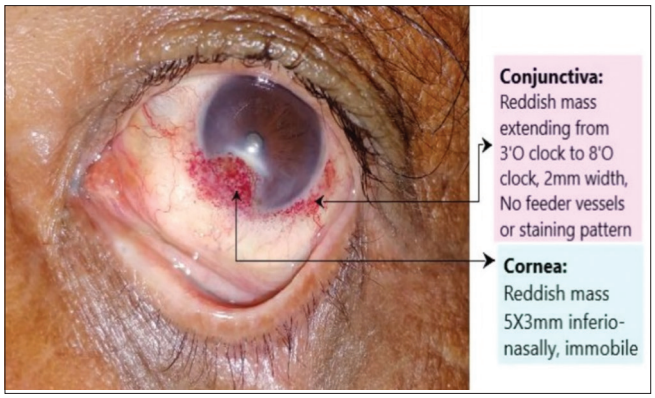


Figure 1: Inferonasal reddish mass in the left eye

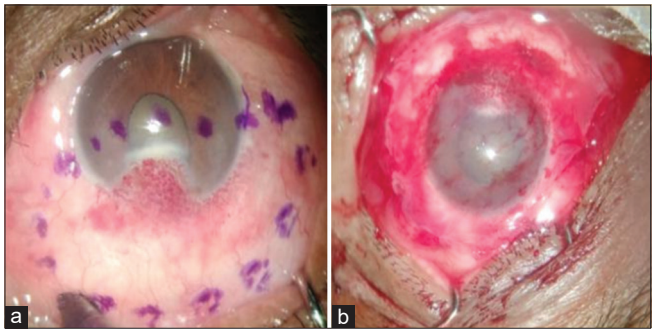


Figure 3: (a) Shows the pre op marking of the mass that was to be excised and (b) image shows the placement of amniotic membrane after complete excision of mass

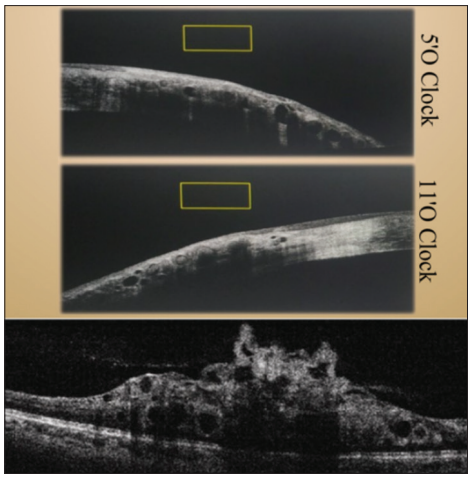


Figure 2: Anterior segment optical coherence tomography of the left eye showing multiple fluid filled lesions at the conjunctiva, cornea, and scleral levels

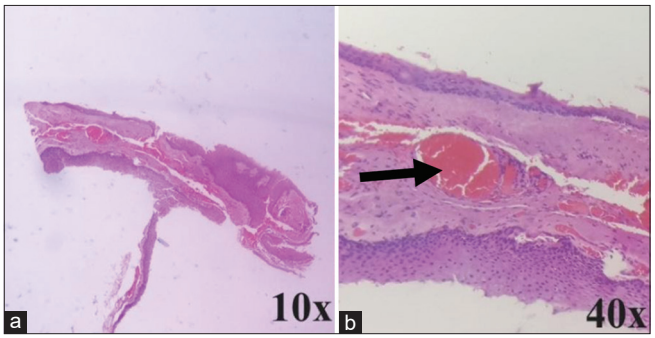


Figure 4: (a) Image showing conjunctival specimen (×10) and (b) image is of the same depicting the blood filled vascular channels (×40) (black arrow)

conjunctiva. They usually occur unilaterally on the bulbar conjunctiva, and the majority of tumors are benign. Conjunctival capillary hemangioma is a slowly developing tumor, which is derived from endothelial cells. It is rarely reported in patients over 60 years of age.[2] Hemangiomas are developmental malformations of blood vessels and usually present as elevated red lesions. According to the age of presentation, hemangiomas can be classified into congenital, infantile, and acquired. Congenital hemangiomas are rare and present in full size at birth. Infantile hemangiomas usually present at birth and grow postnatally followed by involution. Acquired capillary hemangiomas are usually seen in adults but have also been reported in the pediatric age group, and they gradually increase in size.[3] These tumors can be asymptomatic or may also cause visual impairment if the tumor is large. Capillary hemangiomas show a higher incidence in females more in patients with a history of chorionic villus sampling during pregnancy and premature or low-birth-weight infants.[4] Most cases of reported conjunctival hemangiomas are congenital, asymptomatic, and usually occur by age seven. These tumors may be isolated or associated with other ocular capillary hemangiomas such as Sturge-Weber syndrome.[1] On histopathological examination of this lesion, we usually see an intact surface epithelium with positive markers for pericytes and vascular endothelium such as CD31, CD34, and IA-4.[2] The management of conjunctival hemangiomas depends on the presentation, growth, and extent of the tumor.[3] Capillary hemangiomas of the conjunctiva that are small require only close watch. Recently, cases of small conjunctival hemangiomas that are effectively treated with topical timolol have been reported. Orbital and cutaneous hemangiomas are treated with topical propranolol or steroids.[5] Management of these lesions usually depends on the presumptive diagnosis, size, and extent of the lesion. Continuous observation, incisional/excisional biopsy, cryotherapy, chemotherapy or radiotherapy, and enucleation or exenteration can be resorted, depending on character and extent of the tumor.[2,6] Most patients who require excisional biopsy do not require further therapy. In our case, excisional biopsy was done and an amniotic membrane was placed.

All the above pictures were taken only after obtaining the required verbal/oral consent from the patient.

CONCLUSION

It is important to manage each case of the tumors of the conjunctiva individually and observe for their abnormal

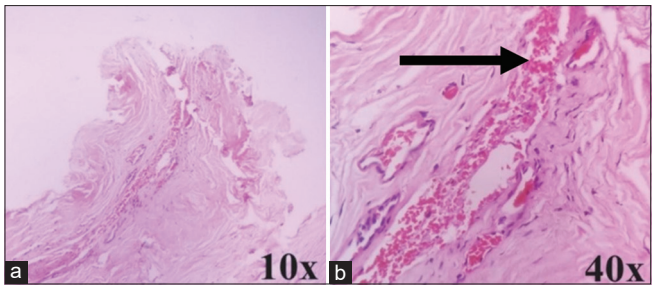


Figure 5: (a) Image showing scleral specimen (×10) and (b) image is of the same depicting the blood-filled vascular channels (×40) (black arrow)

characteristics and growth patterns. Our case is unique that our patient developed the tumor spontaneously and presented to us at the age of 60 years, which is usually rare at this age without any systemic and cutaneous associations. We also report the AS-OCT findings in a case of conjunctival hemangioma which will help in preoperative diagnosis of these cases.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Case Report

Bilateral abducens nerve palsy in scrub meningoencephalitis in a ten year child: A rarity

ABSTRACT

Scrub typhus is caused by Orientia tsutsugamushi from the typhus fever group. Transmitted by chiggers (mite larvae) Leptobrombidium deliensis in India, when humans trespass mite islands, vectors are constantly fed with the bacilli by reservoirs (rodents and birds). It can also be transmitted transovarially and kept in a constant vicious cycle. The disease is often overlooked due to the non-specific clinical manifestations and lack of specific diagnostic facilities making it a challenge diagnostically and therapeutically. Disease manifestations range from fever, rash, lymphadenopathy, eschar to severe pneumonia and neuropsychiatric complications causing morbidity and mortality. Here we describe a case of a ten-year-old child with bilateral abducens nerve palsy caused by scrub meningoencephalitis, which completely resolved in eight weeks with doxycycline therapy.

Keywords: Abducens palsy, children, scrub typhus

CASE REPORT

A ten year old child was referred from the pediatrics department as a case of scrub meningoencephalitis with inability to move both eyes in horizontal gaze for one week. The child presented to the pediatric department with complaints of intermittent high grade fever. Past history was insignificant. Antenatal, birth and post-natal history were normal. The child had been immunized till date. The child attained milestones appropriately. Kernig's and Brudzinski's signs were positive suggestive of raised intracranial tension (ICT). Under the clinical suspicion of meningitis with raised ICT, the child was started on IV antipyretics and antibiotics. Since the patient was negative for malaria and dengue, the patient was prophylactically started on Tab Doxycycline 60 mg BD for scrub typhus. Raised ICT was managed using 3% NaCl. The child was also started on prophylactic antiepileptics. MRI brain revealed T2 hyperintensity of superior cerebellar hemispheres and flattening of the pituitary with prominence of optic nerve sheath. Blood panel for scrub typhus meningoencephalitis was positive-IgM ELISA OD 1.2. Ophthalmological examination in detail was performed. Visual acuity with Snellen's chart was 6/6, and intraocular pressure with Goldmann applanation tonometry was 12 mmHg in both eyes. Color vision with Ishihara pseudoisochromatic plates and contrast sensitivity with Pelli- Robson chart was found to be within normal limits in both eyes. Anterior segment examination with slit lamp bio-microscopy was found to be normal in both eyes. Pupils were 3 mm in both eyes, round and equally reacting to light. Diplopia charting revealed double images in extreme horizontal gazes, levoversion and dextroversion. Fundus examination with indirect ophthalmoscopy revealed inferior nasal margin blurring in both eyes. The child responded to medical management. Patient was advised tab phenytoin 50 mg BD,

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tab prednisolone 30 mg OD and tab acetazolamide 125 mg BD and was discharged and asked to review at Paediatric and Ophthalmology Outpatient departments weekly. By the end of six weeks, the patient's diplopia resolved and extraocular movements were regained with no significant ophthalmological complaints.

REVIEW OF LITERATURE

In Southeast Asia, scrub typhus is a leading cause of treatable non-malarial febrile illness.[1] Evidence suggests high mortality in complicated scrub typhus with central nervous system (CNS) involvement (13.6% mortality), multi-organ dysfunction (24.1%) and approximately 6% of cases die if untreated, and 1.5% if treated, but mortality can reach 13% in areas where the usual treatment does not always work well.[2] Scrub typhus is caused by Orientia tsutsugamushi, an obligate intracellular bacteria, transmitted by bites of chigger mites,[3] inhabiting scrub vegetation.[4] Multiplication of the organism at the site of the bite results in characteristic eschar.[5] It initially begins as papule at the site of the bite and then ulcerates forming a black crust-like cigarette lesion, a central black crust with erythema around its periphery.[6] It is mostly non-pruritic and painless. Hence, it is most often missed by patients. The average prevalence of eschar is around 7%–87% in patients with scrub typhus. Incubation period in human hosts ranges from 5 to 20 days. It proliferates within the endothelial cells of the blood vessels and causes vasculitis, predominant clinicopathological feature of the disease.[7] The proposed pathogenesis for nerve damage is due to microinfarction of the vasa vasorum of nerve, resulting in the stretching of the vessels.[8] CNS involvement in scrub typhus manifests as the presence of meningitis, encephalomyelitis, and eighth cranial nerve involvement resulting in deafness and peripheral neuropathy.[9] Other cranial nerves reported to be associated with scrub typhus are eighth cranial nerve resulting in sensorineural hearing loss and facial nerve resulting in facial nerve palsy.[10,11] Rickettsial fever with isolated third nerve palsy has also been reported.[12] Abducens nerve palsy is a known but rare complication of a few bacterial and viral infections like Mycoplasma pneumonia, cytomegalovirus, Ep-stein-Barr virus, hantavirus, herpes zoster, and measles.[13] Involvement of abducens nerve alone in scrub typhus is very rare, first case reported was by Lee *et al.* (2010).[14]

CONCLUSION

Scrub typhus associated with neuropsychiatric complications has been documented very sparsely in literature with one case each associated with 3, 7, 8 nerve palsies. Among six nerve palsies of the five reported patient in history, all patient were females; three of them had right-sided palsies, one left-sided and one case bilateral. All the above patient were above 13 years of age with oldest at 27 years and none of them below 12 years. Our case, at 10 years of age, the youngest was reported with bilateral palsies of abducens nerve. All the above patient resolved spontaneously over a period of time, so did ours; however, the resolution cannot be strongly documented with the onset of medical therapy since one of the patients developed extraocular movement restriction after starting doxycycline therapy. The strongest correlation between scrub typhus and nerve palsy is that all the above cases were documented in females; either it shows a female preponderance or is due to underreporting is not clearly understood. Henceforth a scrub case must always be viewed with caution in high prevalence states and ophthalmological evaluation must be performed in all cases due to its high morbidity.

This case is reported for its rarity; the first pediatric case of bilateral abducens nerve palsy following scrub typhus infection.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initial s will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Insightful visions – Artificial intelligence large language models in scientific writing

ABSTRACT

In the realm of ophthalmic research, the integration of artificial intelligence (AI) is burgeoning, promising a revolution in how scientific knowledge is written and disseminated. This article explores the burgeoning role of AI, particularly Large Language Models (LLMs), such as OpenAI's GPT series, in easing scientific writing processes within ophthalmology. We delve into the potential of AI LLMs to generate clear and concise text, simplify literature reviews, facilitate collaborative writing, enhance accessibility, and address ethical considerations. Additionally, we examine the emerging capabilities of AI LLMs in generating images and PowerPoint presentations, acknowledging their potential while highlighting current limitations and ethical concerns. Through practical insights and examples, this article underscores the transformative impact of AI LLMs on scientific writing in ophthalmology, advocating for responsible integration to propel research advancement and patient care.

Keywords: Artificial intelligence, ChatGPT, GAN, generative adversarial networks, Google Gemini, large language model, LLM, Microsoft Copilot, publishing, writing

INTRODUCTION

In the world of ophthalmic research, the use of artificial intelligence (AI) is on the rise, promising to transform how we write and share scientific knowledge.[1] AI, particularly large language models (LLMs), like OpenAI's GPT (Generative Pre-Trained Transformer) series, can be incredibly helpful in crafting manuscripts, summarizing articles, and even generating ideas for scientific studies. In a previous edition of Kerala Journal of Ophthalmology, we have looked at the role of AI and machine learning in diagnostics, treatment, guidance, and prognostication in ophthalmology.[2]

Several AI LLMs are now available, many of which have a free version for non-commercial use. Most major Internet companies have their own Large Language Model Generative AIs such as OpenAI's chat GPT,[3] Google's Gemini,[4] Microsoft's Copilot,[5] Meta's LLaMA2,[6] Amazon's Sagemaker, and Apple's AJAX. Here, let us explore how these powerful tools can make scientific writing in ophthalmology easier and more efficient, along with some practical tips for their use.

Generating clear and concise text

Writing a clear and concise manuscript is essential for communicating research findings effectively. AI LLMs can help researchers draft coherent and well-structured manuscripts by suggesting alternative wording, organizing ideas, and even providing relevant citations. A simple prompt to OpenAI's chat GPT,[3] Google's Gemini,[4] or Microsoft's Copilot[5] with specific requirements generates impressive text in seconds. But closer examination may reveal inconsistencies and false information. A better usage would be

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to write a paragraph and ask the LLM to make it more readable or more professional or other requirements.

Tip: Use AI LLMs to outline your manuscript before diving into the details. This can help ensure that your paper follows a logical flow and covers all the necessary points.

Literature review made easy

One of the biggest challenges in scientific writing is conducting a thorough literature review. With AI LLMs, this task becomes much simpler.[7] These models can sift through vast amounts of scientific literature, identify relevant articles, and even summarize their key points. Researchers can use AI LLMs to quickly gather the most up-to-date information on a topic, saving time and effort. But using AI for everything is dangerous; one should not trust it blindly.[8]

Tip: When using AI LLMs for literature review, be sure to verify the accuracy of the information they provide by cross-referencing with other reliable sources. AI is known to "hallucinate" fake information.

Collaborative writing made simple

Collaboration is key to scientific research, but coordinating with multiple authors can be challenging. AI LLMs can facilitate collaborative writing by providing a shared platform where authors can work together in real time, offer feedback, and track changes.

Tip: Set clear guidelines and deadlines for collaborative writing projects to ensure that everyone stays on track and contributes effectively.

Enhancing accessibility

Making scientific literature accessible to a wider audience is essential for advancing knowledge and fostering innovation. AI LLMs can help by providing translations, summaries, and annotations of research articles, making them more accessible to non-native speakers and individuals with different learning styles or even visual impairment.[9]

Tip: When using AI LLMs to translate scientific texts, be mindful of language nuances and cultural differences that may affect the interpretation of the information.

Ethical considerations

As with any technology, it is important to consider the ethical implications of using AI LLMs in scientific writing. Researchers should be aware of issues such as data privacy, bias, and potential misuse of AI-generated content.[8]

Tip: Before using AI LLMs for scientific writing, familiarize yourself with the ethical guidelines and best practices for AI research and ensure that your use of these tools aligns with them.

GENERATING IMAGES

Several AI LLMs can now generate images, but their capabilities and accessibility vary. A few examples include Google Gemini, OpenAI DALL-E,[10] Adobe Firefly, Stable Diffusion, and Midjourney.[11] It is important to note that LLMs capable of image generation are still under development. Ethical considerations like bias and potential misuse are crucial, and responsible generation practices are essential. Generative AI can even enhance pictures, for example, even poor-quality retinal images, as shown by Wan *et al*.[12] Kim *et al*.[13] and Andreini *et al*.[14] showed how their generative adversarial networks were able to synthesize realistic but fake retinal images. See also an example image [Figure 1] that was generated by Google Gemini with prompt for an Indian robotic eye doctor writing an article on a laptop.

GENERATING POWERPOINT PRESENTATIONS

Another interesting type of LLM is AI that generates PowerPoint Presentations, flyer, logos, and so on. A few examples are Decktopus.com, Beautiful.ai, SlidesGo.com, Presentations.ai, designs.ai, Wonderslide.com, Canva.com, Wepik.com, Storydoc.com, AppyPie.com, Tome.app, and so on. These actually make a complete presentation with text and pictures based on prompts given to them, though in the current state, they are often vague and full of mistakes.

CONCLUSION

In conclusion, AI LLMs have the potential to revolutionize scientific writing in ophthalmology, making it easier, faster, and



Figure 1: AI-generated image by Google Gemini of a "part robotic Indian Ophthalmologist typing on a laptop"

more accessible than ever before. A few published articles have included AI as co-author,[15] some of which have now revoked the AI authorship.[16,17] Some articles have discussed whether ChatGPT and other LLMs can in fact be acknowledged as author – consensus is that they cannot.[18-21] What is generally accepted by most journals is acknowledgement of help by ChatGPT or other AI LLMs in the acknowledgement section.[22,23] By leveraging the power of AI, researchers can streamline the writing process, collaborate more effectively, and reach a broader audience with their research findings. With careful consideration of ethical implications and practical tips for use, AI LLMs can be valuable allies in advancing ophthalmic research and improving patient care.

RESOURCES

OpenAI ChatGPT: https://chat.openai.com/

Google Gemini: https://gemini.google.com/app

Microsoft Copilot: https://copilot.microsoft.com/

Meta's LLaMA2: https://www.llama2.space/#hg

OpenAI DALL-E: https://openai.com/dall-e-2

Midjourney: https://www.midjourney.com/imagine

Desktopus: https://www.decktopus.com/

Tome: https://tome.app/

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Photo Essay

All about the taxonomy of retinochoroidal coloboma - A comprehensive portrait collage with truecolor high-resolution confocal fundus images

ABSTRACT

Retinochoroidal colobomas are rare congenital anomalies of the eye. It has varying clinical presentations depending on the extent and involvement of ocular tissue, which can either be unilateral or bilateral. Choroidal colobomas are the most common type of ocular colobomas, and it is important to learn its various types. It can present with other associated systemic and ocular features.

Keywords: Ida Mann classification, optic disc coloboma, retinochoroidal coloboma

The incomplete closure of the embryonic fissure will lead to colobomas at various parts of the eye. One such aspect is the retinochoroidal and optic disc coloboma. It is usually seen in the inferonasal aspect of the eye.

Ida Mann classification of retinochoroidal colobomas was first published in 1937 by an English ophthalmologist names Dame Ida Caroline Mann.[1] According to Ida Mann classification, optic disc and retinochoroidal colobomas have the following types:[2-6]

Type 1: Coloboma extending above the anatomic disc

Type 2: Coloboma extending up to superior disc border

Type 3: Coloboma extending below the lower disc border

Type 4: Coloboma involving disc only

Type 5: Coloboma present below the disc, with normal retina above and below coloboma

Type 6: Pigmentation present in the periphery

Type 7: Coloboma involving only periphery

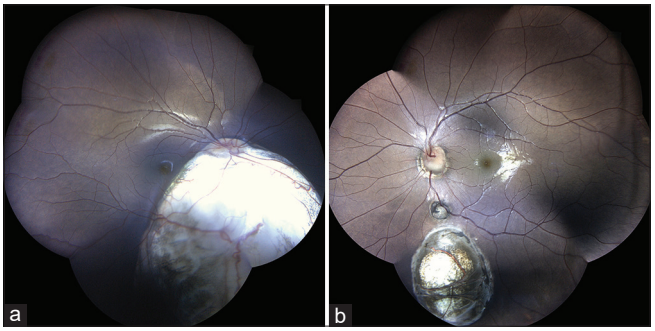


Figure 1: (a) Color fundus photograph showing a retinochoroidal coloboma (RCC) extending right up to the superior border of the optic disc. (b) Color fundus photograph of multiple colobomas, one in the inferior part of the optic disc, a small patch of RCC inferior to the optic disc, and a larger RCC below all the colobomas with intervening normal tissue in between

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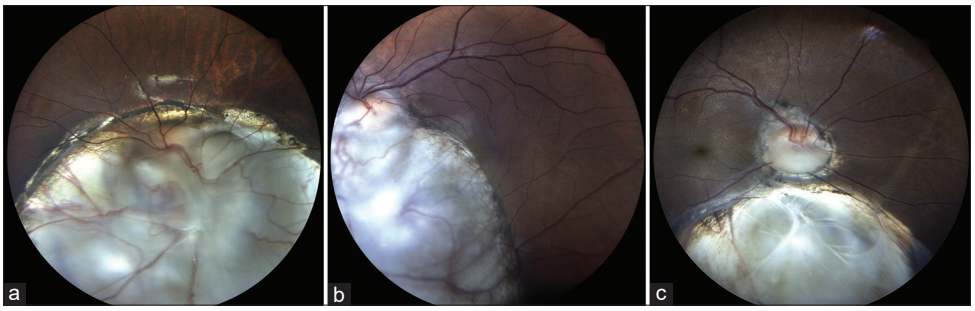


Figure 2: (a) Color fundus photograph showing an RCC extending above the superior border of the optic disc. (b) Color fundus photograph showing an RCC extending up to the inferior border of the optic disc. (c) Color fundus photograph showing optic disc coloboma with RCC extending below the inferior border of the optic disc

But one of the lacunae in Ida Mann classification is that it cannot take into account the various types of disc involvement in the coloboma.[7] Gopal *et al*.[8] classified the optic disc colobomas into six types based on its location and involvement.

Type 1: It presents with the normal optic disc located outside the coloboma

Type 2: It presents with the abnormal dysplastic optic disc located outside the coloboma

Type 3: It presents with an optic disc located outside the choroidal coloboma having independent coloboma with the disc lesion being either concentric or eccentric.

Type 4: It presents with the normal-looking disc located inside the coloboma

Type 5: It presents with both optic disc and choroidal coloboma, with the disc within the choroidal coloboma.

Type 6: It presents with no distinguishable disc substance inside the large retinochoroidal coloboma.

Considering these various presentations, it is important to use both methods of classification to describe the retinochoroidal coloboma to get its full picture.

In this manuscript, we have presented an atlas of various retinochoroidal colobomas with TrueColor high-resolution confocal images [Figures 1 and 2], which according to our knowledge is not yet captured.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published, and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Anatomy of original research article and reporting checklists

ABSTRACT

Writing a manuscript requires a lot of time and skill. The manuscript structure and reporting checklists play an important role for authors to complete the manuscript in a timely manner. This article presents the most salent points, highlights the usual mistakes to be avoided and suggests useful tips for writing a good manuscript.

Keywords: Check list, Manuscript structure, preparation

INTRODUCTION

Benjamin Franklin once said, "Either write something worth reading or do something worth writing". The skill of writing is not merely, the presentation of facts and thoughts, but it also evokes the reader to understand the information effectively. Often clinician finds it difficult, when they come to writing part of an original research article. Here comes the importance of manuscript structure and reporting checklists [Table 1]. The manuscript begins with broad statements, narrows down to the specific objectives and results of your study, and ends with broad consideration. An hourglass structure closely resembles the structure of a manuscript. Figure 1.

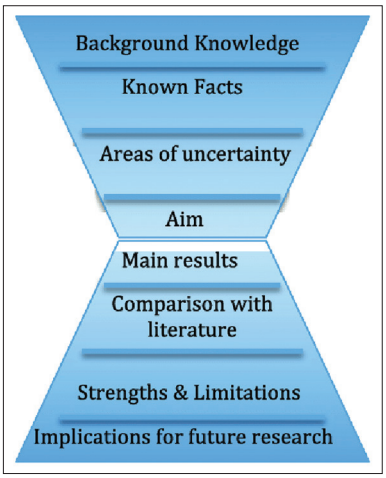


Figure 1: Hourglass Appearance

Salient points

The original research article starts with an attractive title. Title should catch and hold readers' attention, thereby enticing them to read the entire paper. It should be comprehensive and reflect the main content of your research. The ideal length of a good title is around 15–20 words. Next part is the introduction or background. It tells the reader why you undertook this study. It starts with a broad background on what we know about the topic, then, it focuses on what we don't know, and ends with justification for your study. For a research article, one to two paragraphs are ideal for an introduction and it ends with the objectives of your study. Objectives need to be SMART, which means it needs to be specific, measurable, attainable, realistic, and time bound. Next part of the research is a review of literature. It helps the researcher to know more about the topic and explore the

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unknown areas or gaps in research. Ideally, the researcher needs to review a minimum of 15–20 latest articles for review. It gives the relevance of your study. The methodology, or Materials and Method, part mainly explains how the study is conducted ands how data is collected and analyzed. It includes study design, study setting, study period, how many samples are collected for the study, sampling techniques used in the study, inclusion and exclusion criteria, study tools and data collection techniques, the analysis part of the study, and ethical considerations. Don't ever ignore the methodology part as the reviewers are interested in this area for securitizing your article. Each component in methodology is very important and needs to be explained clearly. Next comes the results, where you express the main findings either in tabular or graphical representation. Remember both graphical and tabular forms need to be self-explanatory. Discussion is the part where you compare the findings of your study with other published studies. It gives explanations of your results. The section ends with a conclusion in two or four sentences based on your results. The strengths and weaknesses of the study should be discussed in a separate paragraph. This makes way for implications for clinical practice and future research. The references at the end of the manuscript need to be listed in a manner specified by the journal. The common styles used are Vancouver, Harvard, APA, etc.

The abstract is the last section to be written, but it is the most important part of a paper because it is usually the first to be read and readers use the information contained in it to decide whether to read the whole article or not. An abstract is a stand-alone part of the manuscript giving a brief overview of the contents; it may influence the editors, peer reviewers, and readers regarding the quality of the manuscript. A structured abstract has sections pertaining to Background, Aim, Materials and Methods, Results, and Conclusion. There is a word limit of 250 words for abstracts in the majority of the journals.

Common mistakes/Pitfalls

- Copy pasting immaterial sentences from other articles in introduction and review of literature section.

Table 1: Reporting Guidelines for specific study designs

Name of Check list	Type of Study
CONSORT[1]	Randomized Control Trial
STROBE[2]	Observational studies
STARD[3]	Studies of diagnostic accuracy
QUOROM[4]	Systematic reviews & meta-analysis
MOOSE[5]	Meta-analyses of observational studies in epidemiology

- Methodology part written in haphazard manner, not explaining about study subjects, exclusion criteria and study tools used for research.
- Duplication of results in tables and figures.
- Writing general conclusion and recommendation and not based upon the results of your study.

Take Home messages

- Set a dedicated time aside for writing manuscript.
- Always follow the manuscript structure and checklists.
- Read and understand the author's guidelines and modify the article according to journal's need.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Curated article summaries

1. OUTCOMES AND CLINICAL FEATURES PREDICTIVE OF FUNGAL ENDOPHTHALMITIS

Priluck AZ, Huang P, Breazzano MP. Outcomes and clinical features predictive of fungal endophthalmitis. Am J Ophthalmol 2023;251:104-14.

SUMMARY

Endophthalmitis is a challenging clinical entity and a potentially blinding condition. Fungal endophthalmitis is caused by intraocular fungal infections originating either exogenously from penetrating trauma and surgeries or endogenously from hematogenous spread. It is clinically challenging to distinguish from entities, namely bacterial endophthalmitis, masquerades like ocular syphilis, sarcoid panuveitis, other noninfectious uveitis, and intraocular malignancy. Furthermore, diagnosing fungal endophthalmitis accurately is a hurdle due to low culture positivity rates despite adequate sampling, even in established fungal sepsis.

This is a retrospective clinical case-control study that analyzed all patients receiving intravitreal antifungal injections (amphotericin-B, 5-10 μg/0.1 mL and/or voriconazole 100 μg/0.1 mL) over 7 years at John Hopkins Wilmer Eye institute with the main objective being to identify risk factors that help the treating ophthalmologists distinguish fungal endophthalmitis from masquerade diagnoses at the time of initial treatment decision.

Analyses were made for 75 patients (81 eyes) in terms of clinical course, visual outcomes, and final diagnoses. Patient characteristics and elements of history and examination findings were compared to those of masquerades. Clinicians should suspect fungal endophthalmitis rather than masquerade diagnoses if the below risk factors are present at the time of presentation. These included visual acuity on the day of first intravitreal antifungal injection, presence of an artificial indwelling line, recent sepsis within 6 months, immunocompromised conditions, hepatitis C infection, use of Total parenteral nutrition (TPN), presence of complicated diabetes mellitus, actively treated cancer and immunosuppressive usage within the past year, longer pain duration and visual acuity decline duration before antifungal injection. The study also revealed that visual acuity at the time of injection is a useful predictor of final visual acuity regardless of the final diagnosis. It also stressed on the point that the absence of fungemia is not useful in ruling out fungal endophthalmitis, and only 30% is the overall intraocular positivity rate for detecting the condition even with multiple samplings.

WHY THIS ARTICLE?

Fungal endophthalmitis, given its clinical overlap with various other conditions, makes it a diagnostic challenge and is furthermore complicated by low culture positivity rates. This is the first study that not only links the aforementioned risk factors to fungal endophthalmitis but also confirms they are more likely in fungal endophthalmitis than in other possible mimickers. This helps clinicians strongly suspect fungal etiology for endophthalmitis during their initial evaluation based on risk factor analysis as well as patient characteristics and therefore promptly identify and treat the etiology.

2. RISK OF RENAL DAMAGE ASSOCIATED WITH INTRAVITREAL ANTI-VEGF THERAPY FOR DIABETIC MACULAR EDEMA IN ROUTINE CLINICAL PRACTICE

del Cura Mar P, Carballés MJC, Sastre-Ibáñez M. Risk of renal damage associated with intravitreal anti-VEGF therapy for diabetic macular edema in routine clinical practice. Indian J Ophthalmol 2023;71:3091-4.

SUMMARY

Intravitreal anti-vascular endothelial growth factor (anti-VEGF) pharmacotherapy has emerged as a new standard of care for the treatment of patients with decreased vision secondary to center-involving DME.

However, since it can suppress plasma-free VEGF, systemic side effects have been recognized. Glomerular injury, after intraocular administration of anti-VEGF drugs, has been described in various studies, particularly in patients with co-existent diabetic nephropathy. However, there was no clear association according to previous studies.

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This retrospective cohort study analyzed the effect of intravitreal anti-VEGF drugs (bevacizumab, ranibizumab, or aflibercept) on estimated glomerular filtration rate (eGFR) and microalbuminuria (MicA) in patients with diabetic macular edema and nonproliferative retinopathy without chronic kidney disease.

Medical records of 115 diabetic patients who received intravitreal VEGF inhibitors were reviewed and renal function parameters (Glomerular filtration rate (GFR) and MicA) both at the baseline (1 month before injection) and follow-up (1 month after injection) were measured.

The study showed a worsening of glomerular filtration rate (eGFR) in 12.1% of the cases, and 19.7% had a worsening of microalbuminuria (MicA) level. This implies that only a small proportion of patients had a decrease in renal function parameters after anti-VEGF therapy. Furthermore, no relationship was found between the type of anti-VEGF drug and the deterioration of the renal function parameters. The study, however, highlighted the point that patients with hypertension at baseline were more likely to have worsening of renal function compared to non-hypertensive patients receiving anti-VEGF treatment.

WHY THIS ARTICLE?

Although intravitreal anti-VEGF injection is generally supposed to be safe, there is growing evidence to suggest that it may contribute to proteinuria and impaired renal function due to intravascular depletion of VEGF that affects trophic signaling to podocytes and endothelial cells. Treating ophthalmologists should be cautious about the worsening of renal functions after administration of anti-VEGF, especially in hypertensive patients who may require close follow-up.

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Conflicts of interest

There are no conflicts of interest.

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The Limbus and the pupil: The unsung guardians of vision

ABSTRACT

A detailed description of the Limbus and the pupil.Anatomy of limbus which is a cardinal structure in ocular surgeries and its importance in maintaining corneal integrity is discussed .Also provided is a clinical algorithm on assessment of pupil.

Keywords: Anisocoria, pathological, RAPD, Schwalbe line, scleral spur, stem cell, surgical

FORTRESS OF THE EYE – THE LIMBUS

INTRODUCTION

The limbus, which is the area of transition (1.5–2 mm) between the cornea and the sclera, is of paramount importance in the maintenance of vision. This narrow ring is the source of the stem cells which act as tireless architects, continuously renewing the cornea's surface, ensuring light transmission and clear vision. It is also the area of surgical precision in both cataract and glaucoma surgeries.

ANATOMY OF LIMBUS

The corneoscleral junction or the limbus begins from a plane connecting the end of the Bowman layer (the Corne limbal junction) and the Schwalbe's line (the thickened termination of Descemet's membrane)[1]. Radiating folds called Palisades of Vogt can be seen macroscopically. The five-layered corneal epithelium becomes 8–12-layered thick on reaching the periphery and becomes continuous with the bulbar conjuctiva. It is also the site of passage of the collector channel linking the Schlemm canal to aqueous veins [Figure 1].

- The surgical limbus is formed by two zones:
  (I) The blue zone encircling the cornea corresponding to the area between termination of Bowman's membrane and Schwalbe's line.
  (ii) The white zone which corresponds to the area from Schwalbe's line to the scleral spur, which is a wedge-shaped prolongation from the sclera which lodges the Schlemm canal in its base.
- Pathologists divide it into outer, mid, and inner limbus.
  Outer limbus: Corneal epithelium, Bowman's membrane, bulbar conjunctiva, and tenon capsule.
  Mid limbus: Change in collagen from substantia propria to sclera.
  Inner limbus: Endothelium to the Canal of Schlemm and trabecular meshwork.
- The histological limbus refers to the transition from the regular to irregular arrangement of collagen from the cornea to sclera.

GUARDIANS OF CLARITY – THE LIMBAL STEM CELLS

The limbal stem cells are undifferentiated pluripotent stem cells responsible for the repair of the corneal epithelium, located in the basal epithelium of *Palisades of Vogt* (more prominent inferiorly).

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- Renewal starts with basal cells, and stem cells migrate from the periphery centripetally. This is known as the *Thoft's XYZ hypothesis* [Figure 2] (X, proliferation and stratification of basal cells; Y, centripetal migration of basal cells; Z, desquamation of superficial cells). The health of the cornea depends on X+Y = Z.[2]
- The expression of keratin-19 and the absence of cornea-specific 64-kD protein K3 are special features of limbal stem cells.[1,2]

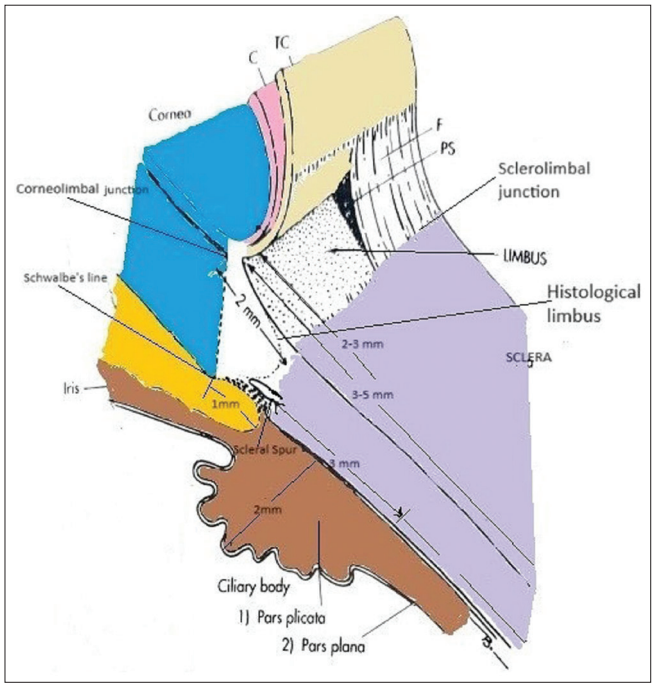


Figure 1: The Schwalbe line and the scleral spur forms the internal boundary of the limbus. The corneolimbal junction (anterior limbus) and the sclerolimbal junction (posterior limbus) form the external boundary

They also inhibit fibroblast-stimulated angiogenesis and help in the maintenance of corneal avascularity.

WHEN THE GUARDIANS FALTER – LIMBAL STEM CELL DEFICIENCY

- Any condition affecting stem cells may cause loss of barrier function between the conjunctiva and cornea, resulting in epithelial breakdown, persistent epithelial

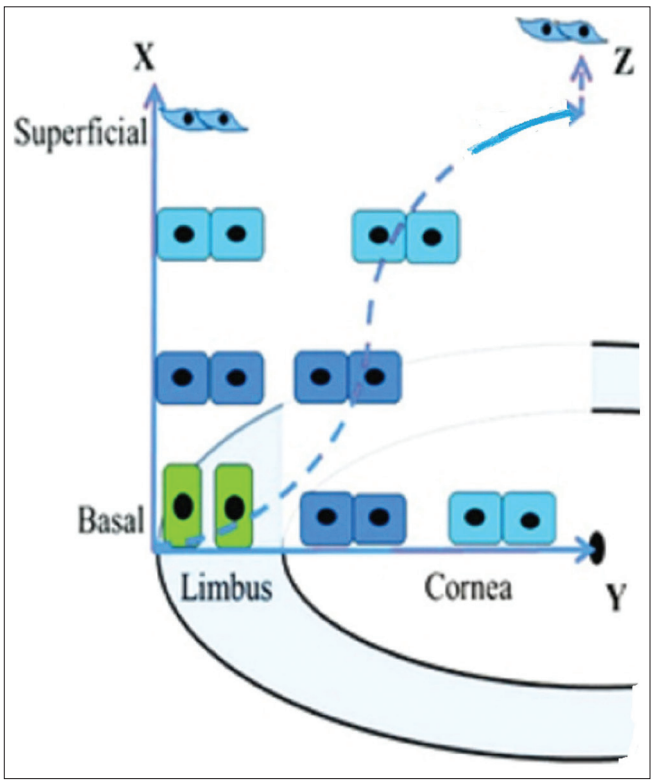
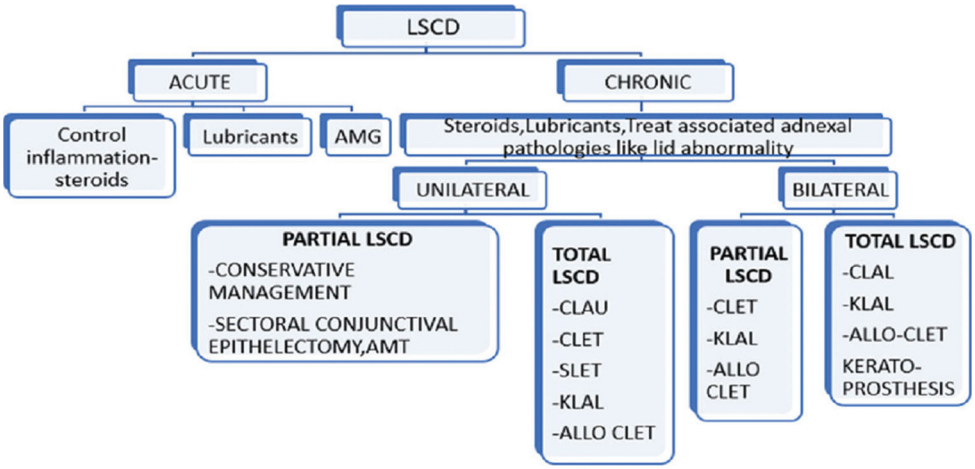


Figure 2: The Thoft hypothesis of limbal stem cells



AMG-Amniotic membrane grafting, AMT-Amniotic membrane transplantation, CLAU-conjunctival-limbal autografting, CLET- cultivated limbal epithelial transplantation, SLET-simple limbal epithelial transplantation, KLAL- Keratolimbal allograft.

Figure 3: Management of limbal stem cell deficiency

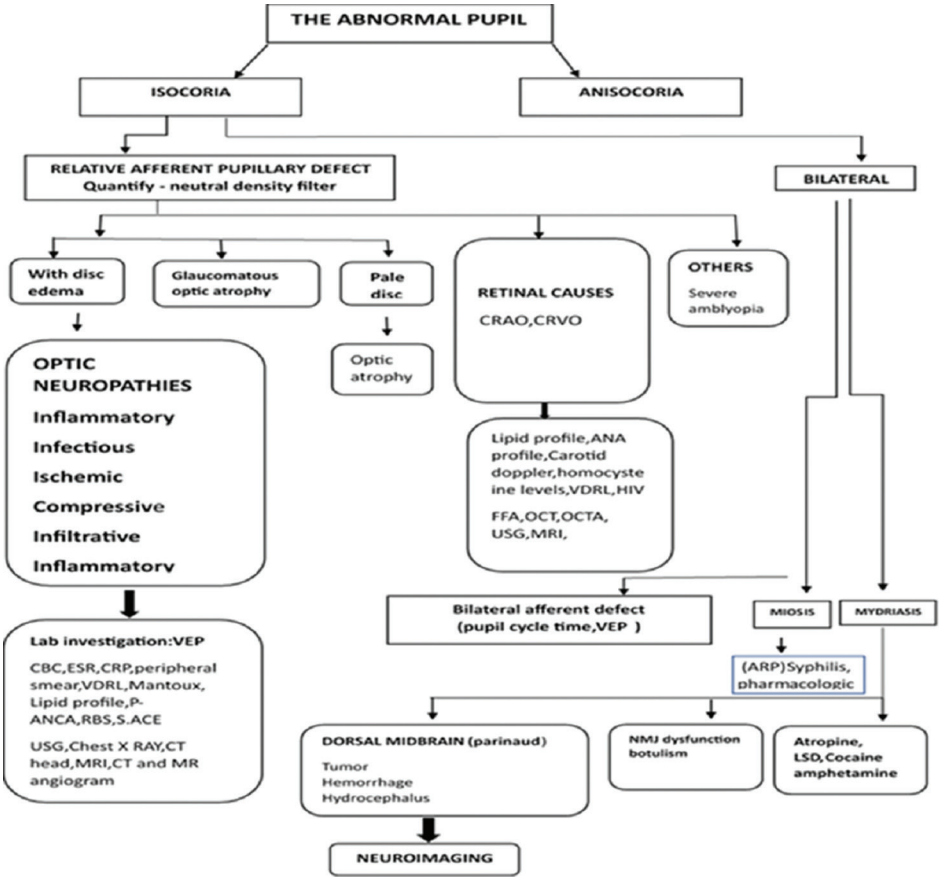


Figure 4: Systematic assessment of pupil

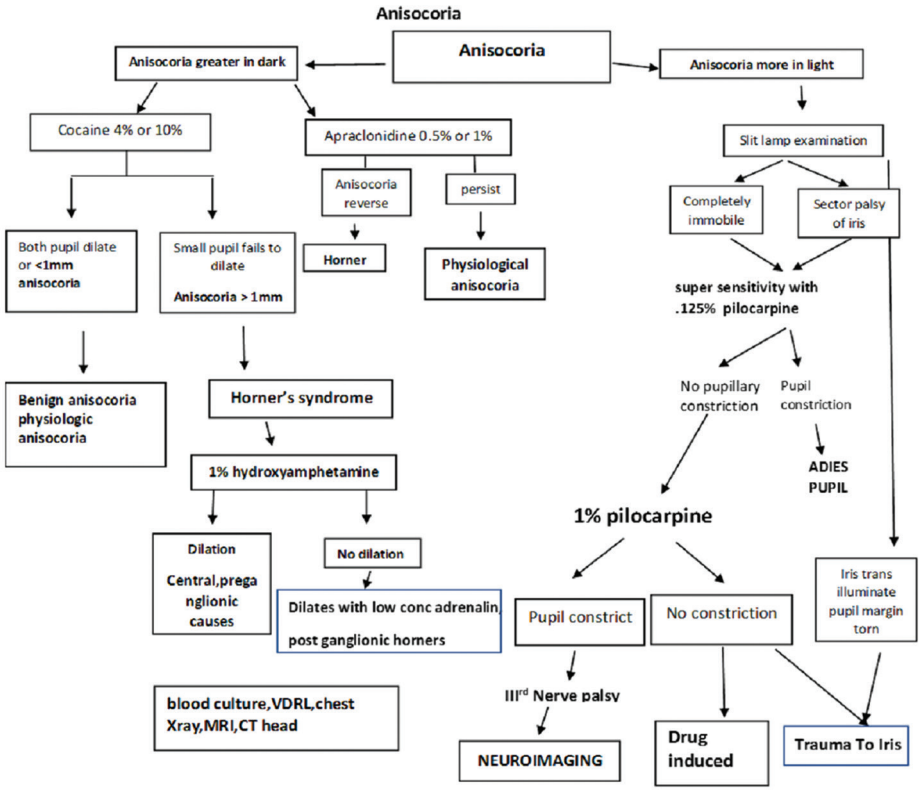


Figure 5: Efferent defects of pupil

defects, corneal conjunctivalization, neovascularization, corneal scarring, and chronic inflammation called Limbal stem cell deficiency (LSCD) [Figure3].

Examples: PAX6 gene mutations, Steven–Johnsons syndrome, ocular cicatricial pemphigoid, GVHD, herpes keratitis, trachoma, chemical or thermal burns, and so on.

MCQ CHALLENGE

Identify the false statement:

a. LSCs are susceptible to damage from ultraviolet radiation.
b. In LSCD, goblet cells are seen in the impression cytology.
c. ABCG2 is present in more than 90% of limbal stem cells.
d. In a patient with moderate LSD, the initial treatment of choice would be amniotic membrane transplantation.

THE OCULAR GATEWAY: THE PUPIL

Concise road maps to pupillary assessment are given in [Figures 4 and 5].[3-5]

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Conflicts of interest

There are no conflicts of interest.

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Complications of laser *in situ* keratomileusis (LASIK)

ABSTRACT

Laser-in-situ-keratomileusis (LASIK) is one of the most commonly done refractive surgeries round the globe. It has become a popular technique of refractive surgery because of lower postoperative discomfort, early visual rehabilitation and decreased post-operative haze. This review journal aims to give a brief outline about intra and postoperative complications of LASIK, clinical presentation and management guidelines for these complications. Intraoperative complications include free cap, buttonhole flap, flap tear, decentered ablation, interface debris and femtosecond laser related complications like vertical gas breakthrough and opaque bubble layer. Postoperative complications include flap striae, epithelial ingrowth, diffuse lamellar keratitis, residual refractive error, refractive regression and many more. The knowledge about these complications help the surgeon in early identification and timely intervention for achieving optimal visual outcome.

Keywords: Diffuse lamellar keratitis, epithelial ingrowth, femtosecond laser complications, flap-related complications, LASIK, LASIK complications, laser *in situ* keratomileusis, refractive surgery, sands of Sahara

BACKGROUND AND INTRODUCTION

The predictability and safety of refractive surgery have improved significantly in recent years. We practice in an era where 6/6 visual acuity is considered the standard for success. Laser *in situ* keratomileusis (LASIK) has become a popular technique of refractive surgery because of lower postoperative discomfort, early visual rehabilitation, and decreased postoperative haze. It is necessary to understand the etiology, pathophysiology, visual safety implications, and management of complications following refractive surgery. This understanding will help surgeons obtain more consistent and predictable outcomes.[1]

Classification

Intraoperative

1. FLAP RELATED
   - i. Decentered flap
   - ii. Incomplete flap
   - iii. Flap tear
   - iv. Buttonhole flap
   - v. Free cap
   - vi. Thin flap
   - vii. Corneal perforation
2. FEMTOSECOND LASER RELATED
   - i. Vertical gas breakthrough
   - ii. Opaque bubble layer
   - iii. Air bubble in the anterior chamber
3. OTHERS
   - i. Subconjunctival hemorrhage
   - ii. Epithelial defect
   - iii. Suction loss
   - iv. Limbal bleeding
   - v. Interface debris.

Early Postoperative

1. FLAP RELATED
   - i. Flap dislocation
   - ii. Flap striae
2. INTERFACE RELATED
   - i. Diffuse lamellar keratitis (DLK)

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ii. Central toxic keratopathy
iii. Pressure-induced stromal keratitis (PISK)
iv. Microbial keratitis
v. Interface haze

3. OTHERS
i. Residual refractive error
ii. Dry eye
iii. Higher order aberration
iv. Reduced contrast sensitivity
v. Transient light sensitivity syndrome (TLSS).

Late Postoperative

i. Regression
ii. Epithelial ingrowth
iii. Corneal ectasia
iv. Posterior segment complication
v. Loss of best spectacle-corrected visual acuity (BSCVA).

INTRAOPERATIVE COMPLICATIONS

Subconjunctival hemorrhage (1/3 cases)

- Incidental trauma to subconjunctival vessels during vacuum application of microkeratome
- Risk factors –
  - Decentered or inappropriate-size suction ring
  - Large/decentered flap in cases with corneal pannus
- Management -Pressure application with meroceal sponge
- Spontaneous resolution occurs in 1–2 week
- Prophylaxis
  - Controlled, gradual, and well-centered application of a suction ring with an average size and well-centered flap
  - Preoperative instillation of topical vasoconstrictors to blanch vessels
  - Chilled balanced salt solution.

Epithelial defect (0.6–14%)

- Risk factors – epithelial basement membrane dystrophy (EBMD), old age, previous corneal trauma, hyperopia, diabetes, history of contact lens use, increased corneal thickness, drying of the flap, type of microkeratome, active suction during microkeratome reverse pass, and iatrogenic trauma with instrument
- Predispose to delayed healing, DLK, epithelial ingrowth, flap striae, and infectious keratitis
- Management
  - Frequent preservative-free lubricants, topical antibiotics
  - Topical steroid stepped up for 2–3 days to reduce the risk of DLK
  - Large epithelial defect (>1 mm) – bandage soft contact lens (BCL)
- Prophylaxis – Careful screening for EBMD, preoperative use of lubricants, minimizing use of topical anesthetic, limiting toxic topical medications, meticulous microkeratome maintenance, and switching off suction during microkeratome reverse pass.

Suction loss (0.06–4.4%)

- Can cause incomplete flap formation
- Risk factors – narrow palpebral aperture, deepset eye, flat cornea, improper eye or head position, improper application of a suction ring, low suction pressure, sudden eye movement
- Management
  - In Microkeratome LASIK(m-LASIK), further forward movement of microkeratome is stopped
  - If flap larger than the intended optical zone (OZ), ablation can be performed
  - If the hinge is in the ablation zone, then the procedure is aborted, and retreatment is planned, preferably surface ablation after three months
  - In Femtosecond LASIK (FS- LASIK), a peripheral asymmetric tear meniscus around the patient interface is the first sign of suction loss following which laser delivery is stopped.

Limbal bleeding

- Secondary to microkeratome blade or femtosecond laser
- Risk factors – large diameter flaps, hyperopia, using inappropriately sized or improperly positioned suction rings, corneal pannus
- Associated with delayed wound healing, sterile interface keratitis, decreased contrast sensitivity, and glare acuity
- Management
  - Gentle pressure on oozing vessels either directly with a dry sponge or by pushing a fold of conjunctiva over limbal feeder vessels
  - After replacing the flap, phenylephrine 2.5% to constrict blood vessels.

Interface debris (0.06–100%)

- Occurs while creating and lifting flap
- Source of debris – meibomian gland secretions, particles from the sponge, talc from gloves, metallic or plastic fragments during use of microkeratome, RBC, epithelial cells, debris from the tear film
- Management
  - Mostly harmless
  - If an inflammatory reaction is elicited, flap lift, and irrigation of the interface
- Prophylaxis – use an aspirating speculum, operate in a lint-free environment, drape the lashes and eyelids, use powder free gloves, nonfragmenting sponges.

FLAP-RELATED COMPLICATIONS

Decentered flap

- Due to a misaligned suction ring
- Risk factor – large cornea (>13 mm)
- Management – pass with microkeratome should not be made when pneumatic suction ring significantly decentered (>1 mm); vacuum immediately discontinued
- Postpone procedure to a later date if repeated attempts at repositioning the suction ring fail
- Prophylaxis – If there is a misaligned suction ring, the suction should be turned off, and the suction ring should be repositioned.

Incomplete/partial flap

- Higher incidence in m-LASIK
- Risk factors – suction loss, flat corneas, corneal scar, low intraocular pressure (IOP), malfunctioning microkeratome, debris in the gears, mechanical block with drape, speculum, eyelash, loose epithelium, or crystallized salt, surgeon prematurely discontinuing pass[2]
- Management
  - Complete LASIK if the flap is of good quality and of sufficient diameter to apply photoablation
  - If not – abort the procedure, reposition the flap, apply BCL, apply topical NSAID, and begin a course of topical antibiotics and steroids
  - The procedure repeated in 3–6 months with deeper microkeratome head.

Flap tear

- Occurs during flap lift
- More common in FS-LASIK
- Risk factors – Large diameter flap with corneal pannus, retreatment procedure, presence of a corneal scar, faulty instrumentation
- Management
  - In case of a small peripheral tear, the flap should be dissected away from the tear
  - If it involves the visual axis, the procedure should be aborted and followed by retreatment with surface ablation
- Prophylaxis – Reducing the flap diameter in the presence of corneal pannus and a careful dissection of the flap, especially in FS-LASIK.

Buttonhole flap (0.03–2.6%)

- Occurs when microkeratome exits epithelium prematurely and then re-enters the flap again
- Risk factors – steep cornea (>48 D), suction loss, large flap, corneal scar or prior corneal surgery, decreased IOP, m-LASIK, and vertical gas breakthrough (VGB) in FS-LASIK
- Management
  - Aborting the procedure, reposition the flap, and putting BCL
  - Plan for retreatment, preferably surface ablation after three months
  - In case, LASIK is performed, the flap should be of a larger diameter and greater thickness
- Prophylaxis – Preoperative assessment of risk factors, intraoperative precautions to avoid suction loss, and lubrication of the second eye.

Free cap (0.01–1.8%)

- Risk factors – malfunctioning or old model microkeratome, flat cornea (<42 D), deep orbit, decentered suction ring, inadequate suction, and small hinge[3]
- Occurs when microkeratome head amputates the hinge resulting in a "free cap" of lamellar tissue
- Management
  - If the flap is found intact and stromal bed is of adequate size (>6.5 mm), a free cap is placed in an antidesiccation chamber with the epithelial side down and kept moist
  - Avoid hydration of the stromal side of the cap as even a small amount of fluid will result in significant flap swelling
  - After laser ablation, the free cap is placed on the stromal bed, allowed to air dry for >5 min, and BCL is placed over it to achieve good adherence
  - Preplaced corneal markings help avoid rotational misalignment that can cause irregular astigmatism
  - If intraop flap loss occurs, the procedure abandoned
- Prophylaxis – regular servicing of microkeratome, avoiding intraoperative drying of the flap and preoperative corneal marking.

Thin flap (<60 microns)

- If the lamellar cut is at or above Bowman's layer
- Risk factors- similar to those for free cap
- Management
  - Uniform thickness thin flap with adequate stromal bed (>6.5 mm), the procedure can be continued
  - Irregular thin flap with inadequate stromal bed – procedure aborted, and retreatment is planned after three months
- Prophylaxis – screening patients for risk factors, proper blade assembly, and adequate suction.

Corneal perforation

- Rare, dreaded complication
- Occurs during flap creation, especially with the old microkeratome model (that required assembly of the thickness footplate), and excimer laser ablation due to either miscalculation of the residual stromal bed thickness (RSBT)

or excessive ablation due to corneal dehydration
- Management
  - Immediate deactivation of suction, remove microkeratome
  - Small perforation – conservative management by repositioning the flap and placing a BCL
  - Large perforation – surgical repair under sterile conditions
- Poor visual outcome due to corneal scar and recurrent epithelial ingrowth
- Prophylaxis – careful microkeratome assembly, preoperative calculation of RSBT, and avoiding intraoperative dehydration of cornea.

FEMTOSECOND LASER-ASSISTED LASIK COMPLICATIONS

Vertical gas breakthrough (0.03–0.13%)

- Femtosecond laser works on the principle of photodisruption. The hot plasma expands and creates intrastromal cavitation bubbles which creates a cleavage plane
- In the presence of a corneal scar or break/abnormality in the Bowman's layer, the gas dissects vertically toward the stroma or epithelium following the path of least resistance [Figure 1]
- This results in an incomplete dissection of the flap with a potential site for buttonholing
- Management
  - If VGB is observed ahead of the advancing edge of the flap, the procedure should be aborted
  - If a VGB is noted behind the advancing edge of the flap, the procedure can be safely continued
- Prophylaxis – Careful preoperative slit-lamp examination to look for corneal scar or any obvious break in the Bowman's layer.

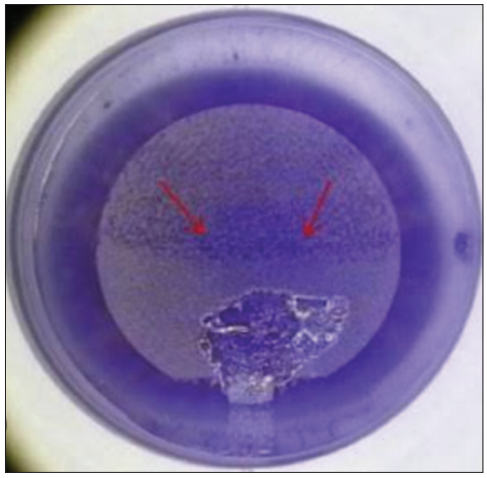


Figure 1: Vertical gas breakthrough. [Courtesy- Ribeiro GC, Krueger RR. Management of bilateral gas-bubble breakthrough during femtosecond LASIK in the presence of anterior basement membrane dystrophy.Journal of Cataract and Refractive Surgery. 2014 Oct;40(10):1736–9. doi:10.1016/j.jcrs.2014.08.020]

Opaque bubble layer (OBL) (5-72.6%)

- Due to the entrapment of gas from cavitation bubbles within the corneal stroma [Figure 2]
- Risk factors – thick cornea, small flap diameter, hard docking technique, corneal hysteresis, use of low laser frequency or energy, and small spot or line separation
- 2 types – early and late OBL
- Early OBL or hard OBL – occurs at the time of laser delivery and appears to be dense
- Late OBL or soft OBL appears after laser delivery has passed through an area and is relatively transparent
- Presence of OBL suggests flap adhesion; hence, flap lifting should be performed carefully
- It disappears after a flap lift; persistence can cause difficulty in pupil tracking for excimer laser delivery
- Wait for it to disappear
- Prophylaxis – soft docking technique with a relatively large diameter flap
- Soft docking implicates docking the patient interface just enough to leave a peripheral ring of tear meniscus that allows the dissipation of gas bubbles through the side cut.

Anterior chamber air bubbles (<1%)

- Due to the migration of cavitation bubbles through the episclera, schlemm canal, and trabecular meshwork into the AC
- Risk factors – Large diameter flap, small corneal diameter
- Bubbles in AC interfere with pupil tracking for excimer laser ablation. Hence, it is ideal to wait for it to disappear before proceeding
- Management – lift the flap cautiously and perform laser ablation.

Rainbow glare

- First described in 2008
- Patients complain of "rainbow glare" when looking at

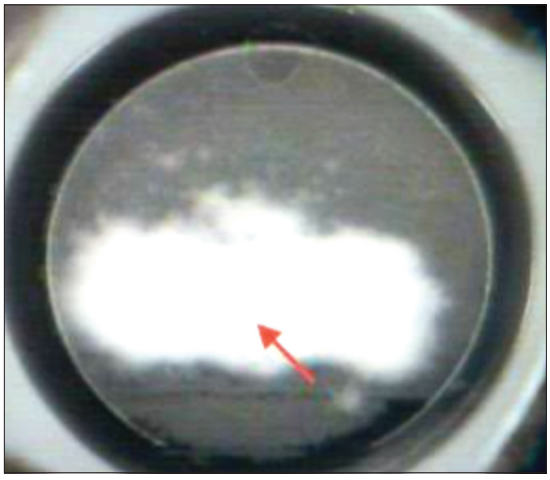


Figure 2: Opaque bubble layer. [Courtesy- Themes U. Opaque bubble layer 2020 Available from: https://entokey.com/opaque-bubble-layer]

white light sources
- Caused secondary to the pattern on underside of the LASIK flap resulting in light diffraction
- Most cases self-limited, but persistent symptoms
- Management – the surgeon can attempt to lift the flap and perform undersurface ablation.

EXCIMER LASER ABLATION-RELATED COMPLICATION

Central island (5.7–11%)
- Well-circumscribed area of unablated cornea with a relatively higher corneal power >3 D and size of >1.5 mm
- Risk factors – broad beam laser delivery pattern, nonuniform corneal hydration, or presence of debris on the stromal surface resulting in nonuniform excimer laser delivery
- The patient complains of glare, halo, ghost images, monocular diplopia postoperatively
- On examination, VA and contrast sensitivity are reduced due to irregular astigmatism
- Corneal topography – an area of hot color surrounded by cool color in the OZ
- Management
  - Prudent to wait for refraction and corneal topography to stabilize before planning a reintervention (since spontaneous regression in 25–80%)
  - Retreatment-Wavefront or topography-guided LASIK
  - Rigid gas permeable contact lens for visual rehabilitation
- Prophylaxis – use of a scanning slit or flying spot pattern of laser delivery, drying of the stromal surface, and checking for the presence of debris prior to excimer laser delivery.

Decentered ablation
- >0.3-mm deviation compromises the visual outcome
- Due to poor fixation, sudden involuntary ocular or head movement, and surgeon's error
- Complain of poor vision, glare, halo, and monocular diplopia due to induced corneal astigmatism
- Corneal topography – asymmetric corneal contour with flattening on one side and steepening on the other
- Management – rigid gas permeable contact lens (RGP CL), miotics to reduce optical aberrations, and decentered PRK or wavefront-guided LASIK or topo-guided LASIK for re-treatment
- Prophylaxis – use of pupil tracking system, dim lighting of the operating room during excimer laser delivery, and preoperative counseling besides intraoperative verbal communication with the patient to maintain central fixation.

EARLY POSTOPERATIVE COMPLICATIONS

Flap dislocation (0.012–2.5%)
- Ocular emergency
- Usually within the first postop week
- Minor trauma – lid squeezing, forceful blinking, and rubbing of eyes can dislodge the flap in this phase
- Risk factors – dry ocular surface, m-LASIK, nasal hinged flap, large diameter/thin flap, presence of epithelial abrasion, poor intraoperative repositioning, excessive irrigation of flap, trauma
- Symptoms – sudden onset blurred or decreased vision associated with pain
- The flap may be dislodged completely (macro-slip) or may be identified only by parallel folds radiating through the flap (microslip)
- Management
  - Flap lift, debridement of epithelium from stromal bed (if present), irrigation of interface for debris removal, and flap repositioning
  - Edges dried meticulously to achieve good adherence, followed by BCL application
  - Sutures if required to realign the flap
- Complete visual recovery if the early presentation
- Secondary complications – DLK, epithelial ingrowth, and interface haze
- Prophylaxis
  - Preoperative counseling to avoid ocular trauma (squeezing/rubbing/contact sports) after surgery
  - Intraoperative superior hinge flap, adequate drying of flap edges, and use of BCL
  - Postoperative counseling to sleep after they return home and use of a protective shield for a week.

Flap striae
- Wrinkles in the flap occur when the flap is not perfectly reapproximated [Figure 3]
- Within first few days
- Two types – micro-striae and macro-striae
- Micro-striae- fine folds in Bowman's layer, occur because of a mismatch of the flap to a new bed
- Macro-striae – full thickness rolling stromal folds occur because of flap malposition or slippage
- Flap striae involving the visual axis affect vision by inducing irregular astigmatism and optical aberrations
- Visualized by retroillumination or using fluorescein under a cobalt blue filter (irregularities in the tear film)
- Risk factors – high refractive error, flap contracture, thin flaps, grossly overhydrated flaps, misalignment during repositioning, and excessive manipulation of the flap during surgery
- Striae formation in high refractive error results from the "tenting" effect due to the contour mismatch of the flap and stromal bed after ablation

- Management – varies from gentle stroking of the flap with a wet sponge on a slit-lamp perpendicular to striae (flap sliding technique) to flap lift and repositioning.
- In cases presenting late-fixed folds resulting from epithelial hyperplasia in crevices
- Management – debridement of corneal epithelium from the flap and exposed stromal bed along with flap lift, repositioning, and stroking with a sponge
- Suturing of the flap is required if folds persist
- Prophylaxis – intraoperative careful handling of the flap, keeping it moist, and prior marking of surgical landmarks at its edge to achieve proper alignment during its repositioning.

Residual refractive error (5–51%)

Overcorrection And Undercorrection

- Causes – inaccurate assessment of refraction or corneal contour change due to CL use, data entry errors in the LASIK machine, and lack of machine calibration
- Environmental factors like operating room temperature, humidity, and atmospheric pressure are hypothesized to affect the tissue ablation depth
- High humidity is presumed to cause stromal hydration and inadequate tissue ablation resulting in undercorrection
- Management – LASIK enhancement with flap rlift, or PRK
- Prophylaxis –
  - Soft CL should be discontinued >2 weeks and RGP CL >4 weeks before refractive workup
  - Cycloplegic refraction should be performed in all cases.

Residual And Induced Astigmatism

- Cyclotorsion from the erect to supine position and poor centration of the eye during laser ablation can cause postoperative astigmatism
- Management – post-LASIK enhancement.
- Prophylaxis – pupil tracking and iris pattern registration (wavefront-guided LASIK) for torsion compensation.

Dry eye (>90%)

- Causes – pre-existing DED, perilimbal goblet cell damage during suction, sub-basal nerve plexus and stromal nerve damage during flap creation, and postoperative inflammation
- Superior hinged flap is at greater risk as the long ciliary nerves enter at 3 and 9 O' clock position
- Management
  - Lubricant drops for 3–6 months, topical cyclosporine, and slow tapering of topical steroids
  - Temporary punctal plugs in severe DED
- Prophylaxis – careful preop screening for DED.

Central toxic keratopathy (0.2–0.77%)

- Risk factors – meibomian gland secretion, marking ink, and talc from the glove
- pain, redness, photophobia, glare, and halo (post-op D2–D6)
- O/E: central corneal opacification, hyperopic shift (36D), and corneal thinning, which progresses over one week followed by a stable phase for 2–3 months and a recovery phase of 3–18 months wherein hyperopia decreases (1–3D) and corneal thickness increases [Figure 4]
- Noninflammatory stromal keratocyte apoptosis and enzymatic lysis of the stroma resulting in corneal thinning is the presumed cause for hyperopic shift
- DD – DLK and microbial keratitis
- Spontaneous regression in most cases
- Prophylaxis – use of powder-free gloves and proper draping to cover lid margins.

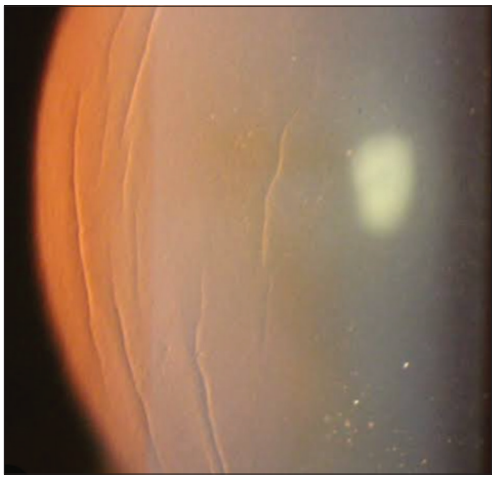


Figure 3: Flap striae. [Courtesy- American Academy Of Ophthalmology. 2020-2021 Basic And Clinical Science Course (BCSC), section 13, chapter 6 S.L.: Amer Academy Of Ophthalmo; 2020]

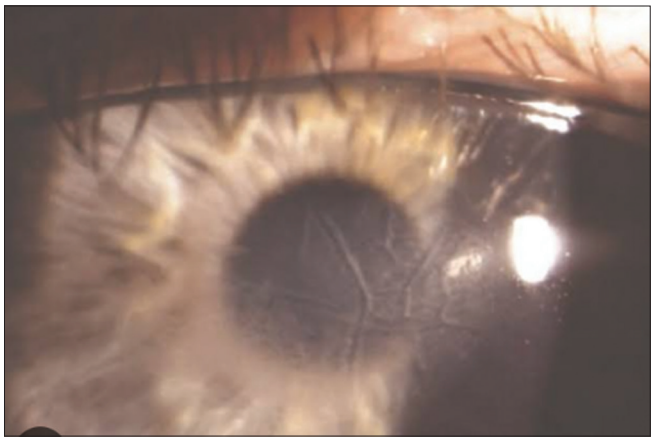


Figure 4: Central toxic keratopathy. [Courtesy: American Academy Of Ophthalmology. 2020-2021 Basic And Clinical Science Course (BCSC), section 13, chapter 6 S.L.: Amer Academy Of Ophthalmo; 2020]

Diffuse lamellar keratitis (1.8–4%)

- Also known as SANDS OF SAHARA SYNDROME [Figure 5]
- Sterile inflammation of stroma/interface following LASIK
- Risk factors – glove talc, marking pen, old microkeratome blade, small suction ring, high-energy FSL, large-diameter flap, chemical toxin and bacterial endotoxin on instruments, residual disinfectants on sterilized equipment, and meibomian gland secretions
- Presents within 24–48 h of surgery with pain, photophobia, redness, or tearing
- Slit lamp – infiltrates – multifocal, granular, peripheral, confined to interface, have characteristic waves of shifting "sands of Sahara" appearance
- Staging and management as proposed by Linebarger *et al.* is given in Table 1
- Untreated severe DLK result in sterile necrosis, melting of flap, interface haze, irregular astigmatism, and hyperopic refractive shift
- In moderately aggressive form – short pulse oral steroids- prednisolone 60–80 mg daily for 5–7 days in conjunction with topical steroids
- Prophylaxis – preoperative screening and management of OSD and intraoperative use of powder-free gloves, drapes to cover lid margin, avoiding tear film debris from reaching the interface, and irrigating the interface after flap repositioning.

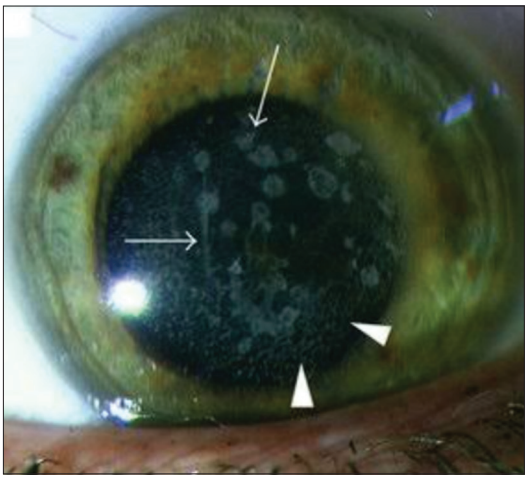


Figure 5: Diffuse lamellar keratitis (sands of Sahara). [Courtesy- Mantelli F, Lambiase A, Di Zazzo A, Bonini S. Sands of Sahara after LASIK in Avellino Corneal dystrophy. Case Reports in Ophthalmological Medicine. 2012;2012:1–3. doi:10.1155/2012/413010]

Pressure-induced stromal keratitis

- also known as PISK, interface fluid syndrome, and pressure-induced stromal keratopathy
- >1 week after surgery with high IOP shows a poor response to steroids, good response to antiglaucoma drugs, and absence of inflammatory cells in the interface
- C/F: poor vision, pain
- Interface haze in mild cases; severe cases – fluid clefts in the interface
- Elevated IOP secondary to steroid response is the presumed cause for fluid accumulation
- Management – antiglaucoma medication and rapid tapering or cessation of steroids to avoid glaucomatous optic neuropathy.

Interface haze

- Risk factors – DLK, ultrathin flap (<90 micron), young age
- Management – responds well to topical steroids in early phase@.

Higher order aberrations (HOA) (2.3–43.5%)

- Symptoms – glare, halo, difficulty in night vision, and blurred vision despite good VA
- Risk factors – large mesopic pupil diameter (>6 mm), small OZ, decentered ablation, central island, flap striae, postoperative residual refractive error, and DED
- Management
  - Decreasing pupil size with topical miotics or brimonidine, use of tinted CL with an artificial pupil and, topography/wavefront-guided enlargement of OZ
  - Use of tear supplements or punctal plugs benefits patients with DED
- Prophylaxis
  - Screen for mesopic pupil diameter >6 mm and avoid LASIK in these cases
  - Wavefront-guided LASIK in cases with high preoperative HOA.

Reduced contrast sensitivity

- Initial decrease for 1–2 months, followed by complete recovery by 3–6 months

Table 1: Diffuse lamellar keratitis – staging and management (Linebarger *et al.*)[4]

Stage	Clinical features	Visual acuity	Management
1	Peripheral white granular cells in the interface	Not affected	Aggressive topical steroids
2	Both central and peripheral white granular cells "sands of Sahara"	May be affected	Aggressive topical steroids
3	Aggregation of dense white clumped cells involving visual axis with the clearing of periphery	Decreased by 1–2 lines	Aggressive topical steroids + flap lift with the Irrigation of interface
4	Severe lamellar keratitis with stromal melting, fluid collection in central lamellae, overlying epithelial bullae	Severely affected	

- More affected in cases with high refractive error, mLASIK, and high postoperative HOA
- Wavefront-guided LASIK results in better contrast sensitivity.

Microbial keratitis (0.005–0.034%)

- EARLY (<2 weeks) – bacteria predominantly Staphylococcus
- LATE (2 weeks–3 months) – atypical mycobacteria, Nocardia, fungus
- Risk factors – DED, blepharitis, immunocompromised state, contamination of surgical instruments or surroundings, intraoperative epithelial defect, use of CL, retreatment, and trauma
- C/F: blurred vision, photophobia, redness, pain.
- O/E: focal infiltrate confined to the interface that later spreads to the flap and underlying stroma
- DD – DLK, CTK
- Management
  - Flap lift, scraping of bed, culture of the interface, and irrigation of bed with antibiotics
  - In addition to routine stain and culture media, Ziehl–Neelsen stain and Lowenstein–Jensen media used to identify Mycobacteria and Nocardia
  - Start empirical fortified treatment including vancomycin (50 mg/ml), tobramycin (14 mg/ml), or gatifloxacin or moxifloxacin
  - Atypical mycobacteria – topical clarithromycin 10 mg/ml), oral clarithromycin (500 mg BD), and topical amikacin (8 mg/ml)
  - Fungal keratitis – Natamycin (50 mg/ml), amphotericin (1.5 mg/ml)
  - Oral Doxycycline (100 mg BD) – to reduce stromal collagenolysis
  - Steroids are discontinued
  - Treatment should be reviewed following the availability of culture and sensitivity reports
  - In severe keratitis, flap amputation for both diagnostic and therapeutic purposes
- Prophylaxis
  - Preoperative screening and treatment of OSD
  - Treating patients with blepharitis preoperatively, discontinuing contact lenses for an appropriate amount of time
  - Use of sterile gown, mask, cap, and gloves by surgeon and assistant
  - Proper sterilization of instruments, betadine preparation of lid, and eye and use of separate instruments for both eyes.

Transient light sensitivity syndrome (TLSS) – 1.1–1.3%

- Complication peculiar to FS-LASIK since the use of FSL cause more inflammation
- Good visual acuity (VA) and photosensitivity without any signs of inflammation at 4-6 weeks
- Management – topical steroids, topical cyclosporine
- Prophylaxis – reducing laser parameters (by 20–30%) and increasing postoperative steroid treatment.

LATE POSTOPERATIVE COMPLICATIONS

Refractive regression

- Defn – >0.25 D shift in ref error
- 30% hyperopes and 5.5%–27.7% myopes
- Risk factors – high refractive error, low RSBT, old age, chronic DED, m-LASIK, and small OZ
- Cause – Compensatory epithelial hyperplasia, decreased flap thickness, an anterior shift of cornea, stromal remodeling, and lenticular nuclear sclerosis
- Management
  - IOP lowering agents like timolol (reduces anterior shift of cornea) – effect is temporary and reverts on cessation of treatment
  - Surgical treatment options include LASIK enhancement, PRK, and laser-assisted subepithelial keratomileusis
- Prophylaxis – corneal collagen cross-linking (CXL) performed with LASIK.

Epithelial ingrowth

- Incidence – 0%–3.9% of cases undergoing primary treatment and 10%–20% in retreatment cases
- Majority present within four weeks
- Pathogenesis – implantation of epithelial cells in the interface during the surgery or later migration from flap edge
- Two types- isolated epithelial pearls in the interface, and epithelial sheets growing into the interface from the periphery
- Risk factors – EBMD or recurrent erosion syndrome, peripheral epithelial defects involving the edge of keratectomy incision, hyperopia, greater ablation depth, spill over ablation m-LASIK, small OZ, retreatment, poor flap adhesion, flap fold/dislocation, perforation of the corneal flap
- Intraoperative faulty instrument handling, fluid from the periphery reaching the interface, and epithelial defect add to the risk
- C/F: foreign body sensation and glare in early stages, and diminution of vision in later stages
- The presence of epithelial pearls and fibrotic demarcation line in the interface and flap melting are signs of epithelial ingrowth
- Management [Table 2]
  - Grade 1 – observation
  - Grade 2–4 – flap lift with mechanical debridement of epithelial ingrowth forms the interface and flap

Table 2: Grading and management of epithelial ingrowth (Probst and Machat grading)[5]

Grade	Signs	Location	Treatment
1	1–2 cell thick fine growth with a white demarcated line along the progressing edge	Within 2 mm of the flap edge	Not required
2	Thick growth showing discrete cells in the epithelial nest with no demarcation line; flap edge may be rolled or gray in appearance	"	Required within 2–3 weeks
3	Several cells have thick opaque ingrowth with no demarcation line; the flap may be rolled with a whitish-gray appearance; peripheral confluent haze at the flap edge	>2 mm from the flap edge	Urgently required
4	Aggressive growth with epithelial cells advancing toward the visual axis; the flap melt may be present	Threatening/involving visual axis	Urgently required

undersurface
  - Mitomycin-C 0.02% application on the interface, fibrin glue application at the flap edge, BCL placement, and flap suturing prevent recurrence
  - In severe cases, flap amputation may be necessary
- Prophylaxis – Careful surgical approach avoiding intraoperative implantation of epithelial cells in the interface and achieving perfect flap apposition without any folds (especially near the flap edge)
- Remove epithelial cells and debris from the interface, avoid wide ablation zone.

Corneal ectasia (0.033–0.6%)

- Considered in patients who developed increasing myopia, with or without increasing astigmatism, loss of UCVA, often loss of BCVA, with keratometric steepening, posterior corneal elevation, with or without central and paracentral corneal thinning and topographic evidence of asymmetric inferior corneal steepening after LASIK procedure
- Risk factors – young age, high myopia, thin cornea, low RSBT, abnormal corneal topography, forme–fruste keratoconus, pregnancy, ocular allergy, and eye rubbing
- Ectasia risk score system by Randleman and colleagues helps identify high-risk patients preoperatively
- Onset varies from 1 week to several years
- Present with diminution of vision
- Refraction shows progressive myopia with astigmatism.
- Management
  - CXL is performed in cases with progressive ectasia
  - Visual rehabilitation with spectacles, RGP CL, or intracorneal ring segments
  - Advanced cases – anterior lamellar keratoplasty
- Prophylaxis – Stringent screening criteria for corneal topography
- Minimum of 250 microns should remain in the stromal bed to preserve long-term corneal integrity
- LASIK should be deferred in eyes with keratoconus and other ectatic corneal disorders.

Posterior segment complications

Due to the presence of myopia and sudden compression-decompression of the globe during suction application (60–100 mm of Hg)

- Rhegmatogenous retinal detachment (0.03%– 0.25%)
- Choroidal neovascular membrane (0.1%– 0.33%)
- Retinal breaks
- Lacquer cracks
- Macular hole (0.03%)
- Retinal hemorrhage
- Vitreous hemorrhage
- Posterior vitreous detachment
- Endophthalmitis

  Prophylaxis – Careful preoperative fundus screening with appropriate management of treatable retinal lesions and counseling of patients with moderate-high myopia for annual fundus evaluation.

Loss of BCVA(Best corrected visual acuity) (0.3- 4.8%)

- Due to the development of cataracts and myopic maculopathy
- The highest incidence is seen in high myopes.

CONCLUSION

Complications of LASIK though rare, can be sight threatening. The demand for the safety of this surgery is mandated because of the fact that relatively healthy eyes are placed at risk every time the procedure is performed. Knowledge, experience, careful use, and maintenance of microkeratome can largely reduce the incidence of these complications.

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Conflicts of interest

There are no conflicts of interest.

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Comment on Management of ocular surface irregularity with scleral contact lenses: Experience from a tertiary eye care center

Dear Editor,

We read with interest the study titled "Management of ocular surface irregularity with scleral contact lenses: Experience from a tertiary eye care center" by Jabbar A.[1] The study provides valuable insights into the use of scleral contact lenses for treating ocular surface irregularities. However, it has certain limitations which can be in improved in the future similar kind of study.

The study is based on a small sample size of 50 consecutive patients (69 eyes), which may limit the generalizability of the findings to a broader population.[2] The study has a relatively short follow-up period of 12 months. The long-term effects and stability of scleral lens use for managing corneal irregularities and ocular surface diseases may not be adequately addressed.[3] The study lacks diversity in terms of the types of ocular conditions studied. It primarily focuses on keratoconus and ocular surface diseases, which limits the scope of the findings.[4]

Lack of discussion on complications: The study mainly highlights the positive outcomes of scleral lens use, but it does not thoroughly discuss potential complications, discomfort, or side effects associated with wearing scleral lenses. Understanding the potential drawbacks is essential for a comprehensive evaluation.[5]

Generalizability: While the study mentions "compelling evidence in the literature," it does not provide a comprehensive review of the existing literature or address potential publication bias in the sources it references.[6]

Lack of age restriction: The study mentions that there was no age restriction for assigning scleral lenses. However, it does not delve into potential age-related differences in treatment outcomes or challenges faced by different age groups.

No detailed discussion of lens materials: The study briefly mentions that materials with high DK values are recommended for scleral lenses to minimize corneal hypoxia. However, it does not provide a detailed discussion of the specific lens materials used in the study.

Short training duration: The study mentions that patients, particularly those with ocular surface diseases, required initial training for using scleral lenses. However, the duration and intensity of this training are not thoroughly discussed. To improve the robustness and applicability of the study's findings, future research could consider addressing these limitations, potentially with a larger, prospective, and more diverse study that includes a longer-term follow-up, and a more comprehensive analysis of both benefits and potential drawbacks of scleral lens use.

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