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Author:
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Description:
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Contributed by:
Dr John Davis Akkara, MS, FAEH (Glaucoma), FMRF (Phaco), Glaucoma, Cataract & Refractive Surgeon, Westend Eye Hospital-Kochi, Chaithanya Eye Hospital-Kochi, Kerala

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Ophthalmic simulation: The need of the times

The coronavirus disease (COVID) pandemic was a hugely disruptive event to medical training. The postgraduate workforce was the backbone of the fight against COVID, at least in India. Thus, whatever training was available to the residents stopped. This brought the need for medical training programs to consider simulation as an alternative method to develop procedural skills into focus. Aviation, police, and the military have been using simulation for a long time.[1] Closer home, simulation training in orthopedics, nursing, anesthesiology, and medical education is widespread and gaining ground.[2] Ophthalmology can benefit from simulation training experiences in these fields.

The important thing in simulations is creativity. Dr. Virender Singh Sangwan, Director of Innovations at Dr. Shroff's Charity Eye Hospital, India, feels that we lay too much emphasis on theory i.e learning science behind surgery instead of the surgical skills, which are mutually exclusive events. Surgical skills are like any motor skills, which have to be improved with practice. The theoretical background is important to be a good doctor but not very important to be a skilled surgeon. He feels that we have the best inputs as medical graduates and yet we churn out average or below average surgeons. This can only be the problem with the system of training.[3]

Only a very small percentage of Indian medical colleges, i.e., nearly 20% advise students to watch, assist, and do wet lab surgeries. Most of the medical schools in India do not have access or will to implement assisted surgeries, perform objective assessments, and provide certification. A dedicated operating room for training is available only in a few centers.

Dr. Sangwan has also suggested a few pointers to train future surgeons. These include assessment of surgical temperament by the online tool (s) in the medical school itself. To those inclined to be surgeons, online virtual reality/artificial intelligence (VR/AI)-based skill-building training and gamification of surgical training are offered.[4] The skills in the mind can be developed much before a structured curriculum is brought out. Mental training, like those given to sportsmen by coaching and visualization, is also advocated. The training includes a wet lab for surgical training in medical school, surgery-based short fellowships, sandwich fellowships with extensive use of technology, simulation, online tools, and surgical YouTube.

AVIATION AND SIMULATION

What does aviation have to teach us about delivering high-quality simulation training? Here qualitative and quantitative data are collected to determine the best course direction for the pilots. They provide scenario-based training, resilience to provide the correct response to startling or surprising situations, development of cognitive reasoning, and the use of training tools from simple to sophisticated.[5] Even practicing pilots use simulation training to update their skills.

Simulation allows for accelerated learning, especially by repetitious skill building which improves the learning curve so that operations on real patients become safer. It helps in refreshing existing skills and the management of complex scenarios or new techniques or management of rare complications and adverse events. This is done in a risk-free environment thereby improving patient safety.[6] This is because simulation uses a controlled environment for training.

WHAT IS WRONG WITH THE CURRENT TRAINING METHODS

There is a huge need for trained ophthalmic professionals in the world.[7] The training of the next generation of ophthalmology professionals as local health providers can be done safely, effectively, and efficiently by simulation. Before I talk about simulation, let me highlight some of the problems of current medical training practice.

The curriculum is too long and students and teachers concentrate on one or a maximum of two surgeries. There is also a lack of opportunity to practice regularly, especially in case of uncommon events/procedures and/or complications.[8] Independent studies have reported that 30–50% of the residents in the US and UK cannot operate independently. In India and other developing countries, 70% or more cannot do so.

The current training system involves the perpetuation of the Halsteadian principle of the "see one, do one, teach one" method.[9] Each training session is very stressful for the trainer, trainee, and the others watching. Therefore, the whole environment is high risk and stressful. Since we

train on real patients, we must assume the inherent risks. There is also a lack of training in team interaction and crisis management.

Lack of rigorous evaluation, readjustment, and correction of problems by assessing and quantifying skills is also a problem as there is too much subjectivity. Individual likes and dislikes create bias making the training dictatorial at times. Thus, there is limited knowledge of the impact of medical training on patient safety and therefore the number of patients experiencing complications is very high.

Disruptive events happen in medical education. Besides coronavirus disease 2019 (COVID-19), there can be man-made and natural disasters, chronic low patient volume, staff shortage, etc. Obviously, the present training model cannot be scaled up. At the same time, it must be remembered that simulation is not a replacement for live surgical education. Prof. R. Kneebone describes simulation as providing an environment meant to take a novice surgeon to a specified level of competence before performing live surgery.[10]

THE POTENTIAL OF SIMULATION IN OPHTHALMIC EDUCATION

Simulation allows for learning skills in basic techniques thereby improving muscle memory. Most of the simulation-based surgical training concentrates on turning out a novice into an advanced beginner and then into a competent surgeon. Gaining proficiency and expertise can happen only in a live surgical environment.

It is not a mere wet lab center. It is a center with skill area, models for learning, feedback, sustained learning, curriculum integration, outcome measurement, simulation fidelity meaning it should feel as close to a real experience as possible, skill acquisition and maintenance, transfer to practice, team training, instructor training, and much more.

For those who are returning to surgical practice after a period of absence, e.g., after maternity leave or injury or illness or to quote again, the global pandemic, it is a boon. It can also be used for practicing the management of rare complications, maintenance of skills, and team training.

The potential for quantitatively tracking one's progress as it is a data-centric program is of immense benefit.

In many institutions, the mean number of cataract surgeries performed by trainee residents in their second and third years is zero. Trainees in the UK have a mean annual trabeculectomy rate of 0.5.[11] It has been found that there is a 40% reduction in posterior capsular rupture (PCR) after a five-day simulation training program.[12]

The evidence from randomized controlled trials in simulation learning showed that motivation and increase in confidence occurred 20 times more and tripled competence in the intervention group as compared to the control group. The GLAucoma Simulated Surgery Trial (GLASS) trial for trabeculectomy skill learning and Ophthalmic Learning and Improvement Initiative in Cataract Surgery (OLIMPICS) for small-incision cataract surgery learning show that simulation makes a real difference. We need to gather more evidence, ensure advocacy, and engage with all stakeholders to disseminate the benefits of simulated learning.[13,14]

Simulation should be integrated into the clinical training portfolio. Steps of simulation-based surgical education include deconstructing the surgical technique, providing explicit instructions, feedback, sustained deliberate practice, and reflective learning. The outcome assessment is done using microscopes linked to a digital classroom and by recording on iPads and marking against Ophthalmic Surgical Competence Assessment Rubrics (OSSCAR).[15,16]

THE ORBIS SIMULATION CENTER

One of the pioneers and biggest users of simulation-supported learning is Orbis International's simulation center. Its completely open-source manual serves as a practical implementation guide for training hospitals and teaching institutions, on establishing a simulation center, designing simulation training, and ensuring ongoing management of the program. The manual provides ophthalmic departments with the resources they need to implement high-quality simulation training for ophthalmologists, ophthalmologists-in-training, ophthalmic nurses, and anesthesiologists. They began with upskilling their own team, purchasing mobile wet lab kits, and then building permanent simulation training centers that can be integrated into a residency curriculum at an institutional level.[17]

The virtual reality simulator in the center enables the user to practice multiple times. It is cost-effective and now it is no longer cost-prohibitive with portable off-the-shelf components. A combination of repeated skill-building giving muscle memory and systems that allow tracking of movements improves the learning experience.[18-21] A skilled teacher is also able to supervise, teach, and enrich the whole process remotely.

They also have the Orbis International Flying Eye Hospital simulation center where training can be provided in basic

and advanced cataract surgery, surgical and medical retina, indirect ophthalmoscopy, pediatric strabismus, trauma, minor operations, etc. It also enables to provide training to a greater number of health care professionals.

CONCLUSION

Simulation training is the way to go for in medical education, especially for surgical specialties like ophthalmology. This alone can ensure a stress-free experience for the trainer and trainee.

Smita Narayanan

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Sustainable global vision care



Eye health and vision have widespread and profound implications on many aspects of life, health, development, and the economy. Poor access to high-quality, affordable eye care is causing vision impairment and blindness.

For the first time, United Nations General Assembly has recognized the need for vision care to eradicate poverty and promote development. A resolution "VISION FOR EVERYONE" was made in July 2021 by unanimous consent of the organization and its 193 members. There are 17 Sustainable Development Goals (SDGs) as proposed by United Nation. SDGs are target-driven goals for 2030, to achieve a better and sustainable future for all. Eye health care falls under SDG-3 which ensures good health and wellbeing for all.

By adding eye care, this resolution raises its visibility globally. Also, this calls for financial help to support developing countries in tackling preventable sight loss.

CHALLENGES TO BE MET

The majority of people having avoidable blindness and moderate to severe vision impairment live in low-income and middle-income countries (LMIC). There is a high need for building cross-sectorial partnership, which includes various aspects of development. Different kinds of leadership skills and capabilities need to be developed to connect the whole system together.[1]

CAUSES OF GLOBAL VISION IMPAIRMENT

Leading causes of vision impairment are cataracts, uncorrected refractive errors, glaucoma, age-related macular degeneration, and diabetic retinopathy. We also see changing epidemiology of eye diseases like global increase in myopia, increased blindness due to diabetic retinopathy, etc. As life expectancy is on the rise, blindness due to age-related macular degeneration is increasing.[2]

By adding two eye health indicators to outcomes reported for SDG-3, namely, the cataract surgery rate and the refractive error coverage rate, 80% of avoidable blindness and visual impairment are accounted for. This enables the countries to measure, report, and allocate resources in a pragmatic manner.

HOW TO TACKLE THE PROBLEM?

Universal health coverage is central in delivering SDG-3. Without affordable, accessible, high-quality comprehensive eye care, universal eye care is not universal. There is a huge disparity between the number of ophthalmologists and allied health care professionals in an area or country and the number of patients needing ophthalmic care. Further, eye care prioritization should be done based on leading causes of visual impairment as well as non-vision impairing conditions.[3]

Ideally, a minimum package of eye care within universal health coverage would include **primary care** (promotion, prevention, and refractive services), **eye care integrated within other services** (neonatal care, school eye health, care of old people), **specialist ophthalmic services** (cataract surgery, management of glaucoma, diabetic retinopathy, and age-related macular degeneration), and **rehabilitation**.[4]

INTEGRATED PEOPLE-CENTERED EYE CARE

To deliver the integrated service, eye health needs to be included within national health plans, policies, and financing mechanisms. Providing services within or close to where people live and work, results in increased access and usage. Eye health education and promotion within communities can lead to improved service uptake.[5,6] A good example is the school health service. Eye care delivery within the primary health care system must be strengthened, as it is the health care professionals at this level who form the basic pillar for assessment, treatment, and referral of patients with eye problems. In many countries, several large non-governmental organizations provide primary care services and are well integrated into networks of secondary and tertiary eye hospitals (spoke and hub model). Public–private partnerships are promising to cover the needs of a large population.

EYE CARE WITHIN SECONDARY AND TERTIARY HEALTH CARE

Secondary eye health services are important for diagnosing

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and managing the leading causes of vision impairment. Secondary and tertiary eye care systems need to be developed in terms of accessibility, affordability, and quality.[7,8]

VISION REHABILITATION SERVICES

Rehabilitation services are a set of services that assist individuals who experience disability, to achieve and maintain optimal functioning. The staggering degree of morbidity due to low vision or blindness in developing countries has not received the attention it deserves, yet. Improving the integration of rehabilitation within health systems needs a lot of effort, not only from the side of the government but also from non-governmental organizations. District, state, and national level organizations of the eye care professionals can link with the corporates through their corporate social responsibility (CSR) schemes or private donors to enhance their societal services.[9-11]

STRENGTHENING TRAINING TO BUILD QUALITY

Our traditional way of ophthalmic education is focused on knowledge of diseases rather than competencies. We need to modify our curriculum to patient-centered, competency-focused learning which is tuned to meet the population's eye health needs.

Surgical training opportunities are insufficient worldwide. New training practices including the use of **simulations** and **remote learning** are essential to build the necessary capacity. While factors like cost and backlog from coronavirus disease 2019 (COVID-19) pandemic are significant, patient safety is the most important reason to use simulation training.[12,13]

TECHNOLOGY SUPPORT FOR EYE HEALTH DELIVERY

Advancing eye health services within universal health coverage will require expansion of service capacity and innovative forms of delivery. Teleophthalmology, mobile health (mhealth), and artificial intelligence offer significant support to innovative eye care delivery through task sharing.[14]

Last but not the least, better health financing is crucial to make progress towards universal health coverage. Investing in universal eye health is a realistic, cost-effective way of improving health and well-being leading to improvement in education, work, and economy, thereby attaining sustainable developmental goals.[15]

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Guest Editorial

Ensuring patient safety in eye care



ABSTRACT

Due to the frequent and rapid development of new drugs, changes in treatment protocols and patient care delivery systems including technology, patient care in health care settings is becoming increasingly complex. However, there is a greater expectation from the patient and the community regarding the quality of patient care, outcomes, and timely delivery. These create stressful situations, making the care process prone to errors, resulting in unsafe incidents. Common errors in ophthalmology include incorrect procedures, identification errors, technical errors, medical or diagnostic errors, and documentation errors. Hence, there is a dire need to create comprehensive methods to support error-free patient care. These include standardization, developing safety protocols, safety checklists, training the staff, creating a platform for reporting, performing a root-cause analysis, monitoring, and periodical meetings to improve and continue the process. Providing a dignified, non-punitive approach with a well-defined system is paramount for ensuring patient safety in eye care.

Keywords: Checklists, eye care, patient safety

"FIRST DO NO HARM"

The guiding principle of patient care. With the recent advancements in the development of new drugs, change in treatment protocols, care delivery systems, and technology, patient care in healthcare settings is becoming complex. As a result of the increasing complexity, the number of people involved in delivering the care also has been increasing. At the same time, there is a greater expectation from the patients and community on the quality of patient care, outcomes, and also timely delivery. The complexity of the care processes, the expectations of the patients, and the involvement of multiple care providers make the care process error-prone, resulting in unsafe incidents. This commonly relates to medication errors, lack of coordinated care, and hospital-acquired infections in general healthcare settings. At the global level, the World Health Organization (WHO) and other international agencies such as Joint Commission, Patient Safety Movement Foundation, etc., highlight the importance of patient safety in health care and urge the national governments to develop strategic plans for the next decade to ensure safety.[1] Recently, the World Health Assembly (WHA) has adopted a resolution (WHA 72.6) on patient safety to make it a global priority, and this endorsed the establishment of World Patient Safety Day to be observed annually on September 17.[2]

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In ophthalmology as well, there is an explosion of new technology both in the surgical techniques as well as in surgical supplies used in surgery. Recent advancements have resulted in the introduction of a number of new intraocular lenses to enhance the quality of vision for patients undergoing cataract surgery, newer intravitreal drugs to treat vascular diseases of the retina, and novel laser technologies to surgically correct refractive errors. In addition, there are also several new pieces of equipment for ensuring a comprehensive clinical assessment that facilitates accurate clinical diagnosis and also to aid in the precision of the surgery performed. Comprehensive eye examination requires several measurements and involves a coordinated effort between ophthalmologists, refractionists, and other allied health personnel. As a result, now, we have more than one modality of treatment for most eye diseases, impacting the delivery of proposed surgical or medical care. All these in turn increase the probability of occurrences of errors in measurement, transcription of measurements, identification of the patient or the eye, or using a wrong implant or intravitreal drug in eye care settings, which may result in harm or poor outcomes to the patients. Whereas both the patients and caregivers are focused on providing good clinical outcomes, they are not aware of the dangers posed by the current complexity in care delivery resulting in safety errors.

The major focus in patient safety in general healthcare is on medication safety and prevention of hospital-acquired infections,[3] whereas it is mostly surgery-related errors in ophthalmology. According to a recently published follow-up study[4] (conducted at the US Veterans Health Administration medical centers) on the assessment of incorrect surgical procedures within and outside the operating room, the highest number of reported errors or adverse events occurred in ophthalmology (72), followed by dentistry (30) and anesthesiology (28). However, when examining in-Operating Room (OR) reported adverse event rates by specialty, dentistry had 1.54, neurosurgery had 1.53, and ophthalmology had 1.06 reported in-OR adverse events per 10,000 cases. Common errors in ophthalmology include a broad range. Some of them are as follows:

- **Incorrect procedures:** Wrong eye surgery, wrong eye anesthetic block, and wrong lens power or design-implanted
- **Identification errors:** Patients presenting with the same name and those mistakenly chosen for wrong procedures
- **Technical errors:** Wrong refraction, wrong mode selection in equipment, wrong formula chosen for calculation, and wrong measurement done
- **Medical or diagnostic errors:** Failure to diagnose the conditions leading to visual loss or postoperative infections
- **Documentation errors:** Transcription errors, documenting the findings in the wrong eye, wrong spectacle prescription, and wrong drug prescription

Apart from these errors, patient fall and patient morbidity and mortality due to uncontrolled systemic diseases are also becoming increasingly common. Failure in detecting the conditions leading to such errors put the systems under great stress.

In a study by Simon *et al*.,[5] 62 cases of safety errors were reported from 900,000 eye operations performed in New York state between 2001 and 2005, which works out an incidence of one major safety error per 14,493 procedures.

Evidence from these studies also suggests that more than half of the errors could have been prevented. Prevention of errors can happen when we understand that these errors happen due to several factors ranging from technology to communication. Thus, ensuring patient safety during the care delivery process in the eye requires hospital-wide effort, involving a wide range of actions to mitigate all factors leading to errors.

Patient safety is fundamental for delivering quality care. Having said that, it is also important to understand that "to err is human" and expecting zero errors from healthcare providers who have to work in an increasingly complex, ever-changing, and stressful environments may be impractical.

Errors in healthcare can be acute or latent.[6] Acute errors refer to errors that are apparent and happen at the frontline and are easily noticed because they are committed by people working at the final point of care delivery and there are no contributory factors. The cause for the error is not carried throughout the process and is unpredictable. These acute errors often happen due to human factors related to fatigue, lack of sleep, etc. This shows that safety is a dynamic and not a static situation, and we need to have processes to address these human factors as well.

In contrast, latent errors caused by latent conditions refer to less apparent system-level failures that contribute to the occurrence of safety errors. This includes contributing factors such as lack of policy, process, inappropriate technology, etc. The latent errors are long-lived and occur as a result of unsafe practices or lack of adherence to safety protocols or not having safety protocols. The unsafe culture developed over

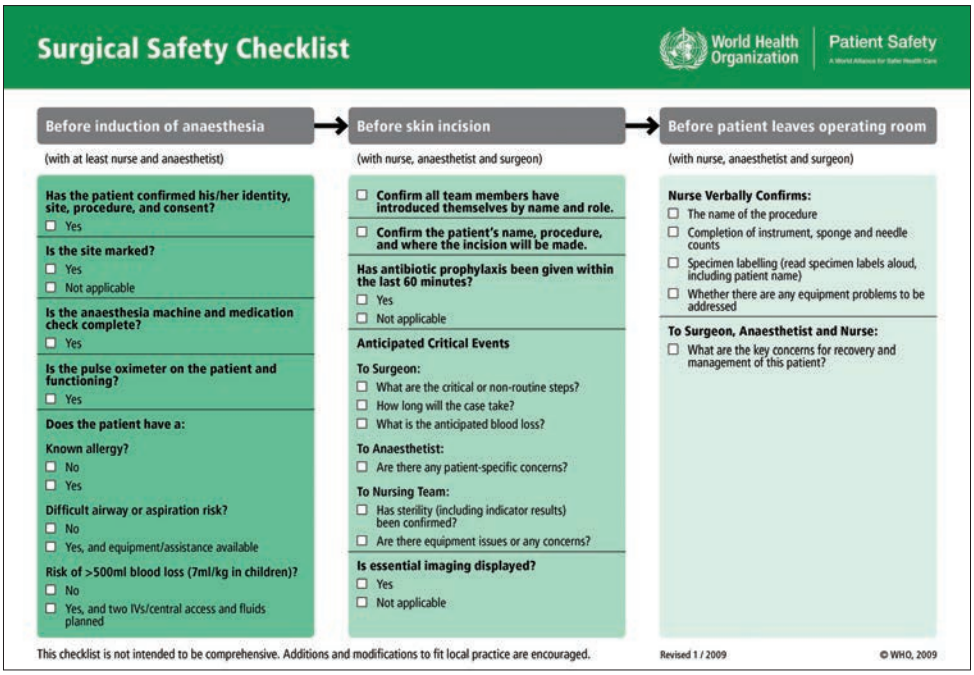


Figure 1: Surgical safety checklists. Checklist courtesy World Health Organization, Safe Surgery, Tool and Resources, accessed 3 May 2022, https://www.who.int/teams/integrated-health-services/patient-safety/research/safe-surgery/tool-and-resources

a period of time lies dormant before combining with other factors or active failures to breach a system's safety defenses. These latent conditions can be identified and removed before they cause an adverse event. However, if systems are not monitored or audited, then the latent conditions may become an accepted and embedded part of the culture.[2]

Although the errors do not result in conditions as devastating as what happens in the other healthcare disciplines, in ophthalmology also, adverse events happen all time, affecting the patient physically, emotionally, and/or financially. In the recent evolvement of patient safety, the mental shift from blaming an individual for causing harm to the systems in which they work has made organizations look for reasons beyond human. The harsh reality of today's healthcare environment is that the systems that support patient care are becoming complex and error-prone, and most organizations lack a comprehensive method for making them less so. Hence, there is a dire need to be proactive than reactive.

Reducing eye surgery adverse events has been a challenge. The cases are short, the time pressure is high, and there are multiple steps in the process from measuring the needed intraocular lens power in the clinic to implanting a non-expired correct lens in the OR.[4] To make an eye organization safer and sustain, the organization needs to follow the following:

- **Standardization**: Standardizing and improving the work processes reduces the risk of errors. In the process, it is vital to identify the process owners who are responsible for creating or updating the standard operating procedures and continue to do risk assessments.
- **Developing safety protocols and safety checklists:** Checklists have proven to nearly double the likelihood that patients will receive proven standards of care[7] and be the best way to reduce safety errors and improve patient safety. Checklists can be prepared for every invasive procedure, based on the WHO Surgical Safety Checklist [Figure 1] and customizing it to the organization by understanding where things can go wrong in their current setting. Compliance with the checklists shall be monitored periodically to prevent non-adherence to checklists.
- **Training the staff:** Ongoing periodical training focusing on patient safety and enhancing the culture of transparency is essential. Assuring the staff that their awareness is key to ensuring patient safety and that they play an important role in assuring quality delivery of care to patients is important.
- **Create a platform for reporting**: Hospital leadership should create a platform to report the errors and make the system efficient to avoid future errors. Training and empowering the staff involved in the processes to identify the root causes and in eliminating them plays a huge role in a successful reporting system.
- **Root-cause analysis:** Doing a root-cause analysis for all reported incidents helps in understanding the real cause, which most of the time may go beyond the

human involved in the process. Identifying such causes through root-cause analysis shall help in the elimination of the correct contributing factor and also prevents the recurrence of errors.

- **Monitoring the processes:** Monitoring and review of the safety processes continually ensures efficacy and helps in safer systems. The findings shall be used for further refinement of the processes and, if needed, update or modify to make the processes error-free.
- **Improve and continue:** Periodical meetings to reinforce the organization's commitment to patient safety helps in continuous quality improvement. Regularly identifying and learning from defects helps in the prevention of error recurrences.

Over the years, healthcare providers had viewed medical errors and adverse events as either an inevitable byproduct of complex care or the result of provider incompetence. In the process, the healthcare providers were often blamed for the error. Yet, most of the time, these situations occurred unintentionally. Humiliating or otherwise disciplining caregivers tend to perpetuate a culture of secrecy that impedes effective root-cause analysis and future improvement. No matter how well-intentioned, well-trained, and hard-working, healthcare providers are humans and can make mistakes. A more enlightened approach is entirely non-punitive and humans are protected from making mistakes by providing an enabling environment with safer systems, well-designed processes, and open and transparent reporting, where a safety culture prevails.[8]

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Review Article

Update on imaging and anti-VEGF therapy for diabetic retinopathy

ABSTRACT

The classification of diabetic retinopathy has been based on 7-field photographs. With advances in retinal imaging, there is an unmet need to reclassify this condition as new predictive factors have been identified in the peripheral retina. In addition, we have transitioned from an era of laser treatment for vision-threatening complications to robust evidence that anti-VEGF therapy can modulate the diabetic retinopathy scores. In this review, the literature on both retinal imaging and role of anti-VEGF on diabetic retinopathy highlights both the merits and shortcomings of available evidence in this area.

Keywords: Anti-VEGF, diabetic retinopathy, widefield retinal imaging

INTRODUCTION

The worldwide prevalence of diabetes mellitus (DM) has increased from 1.2% in 1971 to 9.3% in 2019 and the overall projected numbers of people with diabetes are 700 million in 2045.[1,2] Diabetic retinopathy (DR) is one of the most significant microvascular complications of DM. Vision-threatening DR, comprising of diabetic macular edema (DME) and proliferative DR (PDR), needs to be detected at an early stage to prevent its progression to advanced stages.[3-7] The progression of DR can be documented using clinical photographs at regular screening intervals.

DR is characterized by endothelial injury, loss of pericytes and breakdown of blood retinal barrier, and major pathogenetic biochemical pathways have been discovered related to chronic hyperglycemia.[8] Of the several factors driving the pathways, the most well established is that of the vascular endothelial growth factor (VEGF).[9,10]

Since the 1960s, panretinal photocoagulation has been the mainstay of treatment of eyes with PDR, supported by data from the DRS study.[11] However, DRS study also showed that 50% of eyes with PDR would still progress to severe vision loss even after Pan Retinal Photocoagulation (PRP).[11] VEGF levels in the vitreous have been shown to reduce after PRP, with a clinical regression of neovascularisation, reduction of vitreous hemorrhage and chance of future tractional retinal detachment.[12] Nevertheless, PRP has several limitations, including permanent loss of peripheral field of vision, night blindness, worsening of macular edema, vitreous hemorrhage, uveal effusion and transient loss of central vision.[13] Furthermore, it requires a clear media and good patient cooperation. Intravitreal anti-VEGF therapy has become the standard of care for eyes with DME, with multiple randomised clinical trials demonstrating its effect on visual outcome in DME.[14,15]

Decades of research has shown that Non-Proliferative Diabetic Retinopathy (NPDR) may be prevented from progressing to

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PDR by appropriate control of modifiable risk factors. There is, however, no specific treatment for NPDR, except for close observation. Recent literature on anti-VEGF in DME has shown that NPDR may be reversible and this may prevent development of vision-threatening complications.

The purpose of this review is to summarise the evidence of anti-VEGF use in DR and to explore into imaging modalities examining the peripheral retina, which may improve the detection rate of DR and improve treatment and follow-up. The authors performed a literature search using Pubmed/Medline and Google Scholar up to February 2021 using keywords "wide-field imaging," "diabetic retinopathy," "proliferative diabetic retinopathy," non-proliferative diabetic retinopathy," "DRSS" and "anti-VEGF."

RETINAL IMAGING FOR DR

Conventional color fundus photography

The Early Treatment Diabetic Retinopathy Study (ETDRS) group was the first to classify DR eyes as having mild, moderate, severe, very severe NPDR and early and high-risk PDR.[16-18] This was done using seven 30-degree field stereoscopic photography which could capture around 35% of the whole retina[13,19-21] The ETDRS-Diabetic Retinopathy Severity Score (DRSS) was developed that scored each eye from 10 (no retinopathy) to 85 (advanced PDR), with a progression of DR defined as 2- or 3-step change in the DRSS.[22-24] Recently, the Diabetic Retinopathy Clinical Research Network (DRCR.net) has evaluated 200° ultra-wide field imaging (UWFI) for DR grading as against ETDRS 7-field photography and found them to be equivalent.[25]

Ultra-wide field imaging

UWFI of the retina captures 82% of the total area, which may be more relevant in evaluation of the peripheral retina in PDR eyes.[26-28] UWFI has helped to identify predominantly peripheral lesions (PPL), namely, hemorrhages, microaneurysms, intraretinal microvascular abnormalities, venous beading and neovascularization, which are more severe outside the ETDRS 7 standard photographic fields.[29] These PPLs can identify at-risk DR eyes independent of the ETDRS-DRSS level, because these eyes have larger areas of capillary non-perfusion (CNP) on angiography.[29] Furthermore, DRSS grades have been found comparable to UWFI in the protocol AA, and the inclusion of PPL to ETDRS grades may improve the identification of eyes at risk for PDR.[25] The incorporation of UWFI in the existing classification of DR has been proposed.

RETINAL PERFUSION

Fundus fluorescein angiography was not a part of the original ETDRS classification for severity of DR and has not played much role in classification of the disease, albeit its importance in identifying high-risk lesions.[30] CNP is generally measured manually in disc areas or by binarization techniques.[31-34] More recent studies are aiming for automated detection of non-perfusion.[32]

Optical coherence tomography angiography (OCTA)

OCTA has made the visualization of retinal vasculature possible without dye injection. The superficial and deep retinal capillary plexuses and choriocapillaris can be imaged individually in high resolution, along with measurement of other vascular parameters, such as vessel density, perfusion index, foveal avascular zone area, fractal dimension, etc.[35-37] OCTA may detect vascular abnormalities, such as microaneurysms in the deep capillary plexus that is not visible on FA, and help in detecting DR in patients who have normal fundus on ophthalmoscopy.[38,39] OCTA may also be used to characterise diabetic macular ischemia.[40]

Ultra-wide field angiography (UWFA)

UWFA is a more practical alternative to standard field Fluorescein Angiogram (FA) by nullifying the need for repeated imaging for peripheries and has become the investigation of choice for understanding the extent of CNP areas. But it is also invasive. In this regard, wide-field OCTA has emerged as a comparable platform to UWFA for evaluation of peripheral ischemia in DR as a non-invasive modality.[41]

Wide-field OCTA, apart extensive characterisation of neovascularisation in DR eyes, can detect peripheral non-perfusion superior to FA, with segmentation of individual layers, and needs to be evaluated further in this regard.[42] With improvements in scanning speed, resolution and field of view, OCTA has the potential to replace FA for characterisation of retinal microvasculature in DR.[43]

AUTOMATED DETECTION OF DR PROGRESSION

Artificial intelligence (AI) based platforms have been used for DR grading with significant efficiency and accuracy. AI can grade DR as referable or non-referable DR. Deep learning-based AI can grade DR into ETDRS or similar stages, along with presence or absence of DME.[44,45] There is a lot of scope in automated detection and analysis of PPLs with UWFI for the prediction of DR severity and progression.[29,46] Automated detection of CNP areas may also be a very reliable method of detecting PDR risk.[47-50] UWFA images have been used for automated analysis and has been found comparable to human graders.[51-53]

IMPACT OF ANTI-VEGFS ON RETINAL NON-PERFUSION AND DR PROGRESSION

CNP correlated with DR and DME severity, however, the threshold at which the complications begin, is less well understood.[54,55] A recent study found that eyes with more than 107.3-disc area of CNP were at highest risk of developing PDR.[56] The RECOVERY study suggests that aflibercept therapy in PDR eyes without DME may show reduced progression of CNP in addition to an improvement of DRSS scores.[57] However, more reports suggest no improvement of non-perfusion with anti-VEGF therapy. Other reports also indicate that anti-VEGF therapy may reduce leakage.[32,58-60] Anti-VEGF therapy may also improve DRSS scores.[15,21,31,32,61-64] The post-hoc analysis of DRCR.net Protocol T[65] found that the DRSS scores improved with all available anti-VEGF drugs, similar to previous studies.[14,15,66-73] This improvement was sustained in around 70% of PDR eyes.[65] The RISE and RIDE trials also found improvement of DRSS scores in PDR eyes with ranibizumab and needed PRP less frequently.[74] In the PRN dosing phase of RISE/RIDE studies, almost 70% patients maintained their improvement of DR severity, along with visual improvement with repeated injections.[68] A delayed progression of CNP was also observed. Therefore, patients may require continued treatment with anti-VEGFs. In the VISTA and VIVID trials, aflibercept improved the DRSS scores for a maintenance period of 148 weeks.[73]

Prospective clinical trials of anti-VEGFs in PDR

DRCR.net Protocol S was designed to evaluate intravitreal ranibizumab as a monotherapy for treatment naïve PDR eyes, against PRP.[75] Ranibizumab showed equivalent efficacy for regression of PDR when compared to PRP, and even had better visual outcomes. This trial suggested that aggressive anti-VEGF therapy in PDR is more beneficial than PRP alone.[76]

In eyes with PDR along with vitreous hemorrhage, anti-VEGF treatment may be used to treat the underlying DR, although DRCR Protocol H did not show any significant difference in vitrectomy rates between ranibizumab-injected and sham-treated eyes.[77]

The CLARITY trial compared monotherapy with aflibercept and PRP for treatment naïve PDR eyes.[78] After 2 years of follow-up, higher proportion of eyes getting aflibercept showed neovascularization regression compared to PRP-treated eyes. Aflibercept also led to higher improvements in DRSS and less chances of developing newer complications.

The PROTEUS trial was a randomised trial for comparing PRP against PRP with additional ranibizumab for regression of high-risk PDR features.[74] The study found that combined treatment showed higher chances of complete regression of neovascularization compared to PRP alone. Thus, a combined approach may have more sustained effect.

The PRIDE study is an ongoing clinical trial that compares the effects of PRP alone versus ranibizumab alone versus PRP-ranibizumab combined therapy in PDR in terms of change of neovascularization area over 12 months.[79]

Prospective clinical trials of anti-VEGFs in NPDR

In the DRCR.net Protocol W trial, moderate to severe NPDR eyes without DME received aflibercept and it was found that over 2 years, aflibercept reduced the the risk of developing vision-threatening complications, both PDR and DME.[80] The ongoing PANORAMA trial will evaluate the role of aflibercept injections versus sham in severe NPDR without DME, towards DRSS improvement during a 2-year period.[81] Over 100 weeks, the rate of development of vision-threatening complications, DME, PRP requirement and change in BCVA also will be measured. The dosing schedule has been kept as 2 mg every 16 weeks for 2 years or every 8 weeks in the first year followed by PRN dosing in the second year. After 24 weeks, almost 60% of eyes getting aflibercept have achieved 2-step or more improvement in DRSS compared to sham, irrespective of the dosing schedule, and they also had reduction in chances of development of vision-threatening complications.[82]

RECLASSIFICATION OF DR

The DRSS was initially developed with 7-field photography system, however, we have additional imaging tools at hand, namely, UWFI, OCTA and UWFA. Because peripheral retinopathy changes may be identified in a significant number of eyes outside the ETDRS fields, modalities, such as UWFA may increase the DRSS severity.[26,27] These eyes may also have higher progression rates of DR.[29,83] Because the DRSS was standardised for treatment naïve eyes, the utility of the same scoring system in monitoring eyes that have received treatment in the form of PRP or anti-VEGF has been long debated. The only factor significantly associated with 2-step or more DRSS improvement with antiVEGF therapy is baseline DRSS.[84] In addition, an eye with moderate to severe NPDR may be more responsive to DRSS improvement than an eye with mild NPDR at baseline, despite being more unstable. Hence, when the moderate to severe NPDR eye improves to mild NPDR stage, this "induced" state is quite different from a "treatment naïve" mild NPDR eye of the same DRSS.[85,86] Hence, the DRSS fails to adequately describe this post-treatment underlying state in DR eyes. On the contrary, a UWFA at this point might help in evaluating the peripheral ischemia, which in turn might help predict the natural

course and further treatment response in the "induced" and "treatment naïve" eyes. AI-based standardization of UWF images may further help in achieving a uniform criterion for treatment purposes and for monitoring eyes in clinical trials.

Literature regarding UWFA or wide-field OCTA for documentation of peripheral ischemia in DR and effects of anti-VEGF is scarce. Patients requiring long-term maintenance therapies with follow-up might be more compliant towards non-invasive imaging techniques, such as UW-OCTA.[87,88]

CURRENT RECOMMENDATIONS

The American Academy of Ophthalmology Preferred Practice Pattern committee has recommended that anti-VEGF drugs may be advised in PDR patients in place of PRP only in patients who can be followed up regularly and in the presence of DME. It is also advised in eyes where a PRP is not possible, namely, presence of media opacity or vitreous hemorrhage.[89] There is growing evidence on anti-VEGFs in severe NPDR eyes that would normally not be considered for PRP. A significant proportion of these NPDR eyes may be at a risk of progressing to PDR but prediction of rate of progression remains challenging. Furthermore, considering the cost of treatment with anti-VEGF drugs, optimal selection of high-risk and highly motivated patients are required.

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Conflicts of interest

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Original Article

Comparative evaluation of the thickness of macula, ganglion cell layer, and retinal nerve fiber layer in emmetropes, myopes and myopes with lattice degeneration by using Cirrus high-definition optical coherence topography

ABSTRACT

Purpose: To know the quantitative thickness changes occurring in the macula, retinal nerve fiber layer (RNFL), and ganglion cell layer (GCL) of the retina in myopic eyes (ME) and in ME with lattice degeneration (ME-LD) in comparison to emmetropic eyes, with the help of Cirrus HD Optical coherence topography (OCT) 5000 (Carl Zeiss Meditec Inc.). **Methods:** Hospital-based, nonrandomized prospective study involving 90 eyes, divided into three groups – Group A comprising 30 eyes with 3– 6D of myopia, Group B comprising 30 eyes with 3– 6D of myopia with LD and Group C with 30 emmetropic eyes. The central macular thickness (CMT), RNFL, and GCL analysis was done with Cirrus HD OCT 5000 (Carl Zeiss Meditec). **Results:** The CMT was significantly higher in Group A and B than Group C. There was no significant difference in CMT between Group A and B. Any of the group did not reveal significant difference in parafoveal thickness in any quadrant. Average RNFL, average GCL + inner plexiform layer (IPL), minimum GCL + IPL was significantly thicker in Group C than Group A and B. There was no significant difference between in CMT, average RNFL thickness, average GCL + IPL between Group A and B. **Conclusion:** There is a significant change in thickness of macula, RNFL, and GCL between emmetropes as compared to myopes and ME-LD but not between myopes and ME-LD. This underscores the need of incorporating a myopic normative database in the present normative built-up of Cirrus OCT. Patients of ME-LD, when being evaluated on different OCT-based parameters, can be considered the same as the myopic population.

Keywords: Cirrus high-definition optical coherence topography, central macular thickness, ganglion cell layer, myopic lattice degeneration, retinal nerve fiber layer

INTRODUCTION

Myopia has become an important public health scare affecting nearly 13.1% of school-going children in India[1] and as high as about 84% in high school students in Taiwan.[2] It is an independent risk factor for multiple ocular pathologies like amblyopia, open-angle glaucoma, ocular hypertension, posterior subcapsular cataract, retinal detachment, different myopic tractional maculopathy. With the advent of Optical coherence topography (OCT), it has become possible to do a quantitative real-time assessment of different layers of the retina. The study of macular thickness (MT), ganglion cell layer (GCL), and retinal nerve fiber layer (RNFL) thickness analysis has become an important tool in the assessment of the risk factors, early diagnosis, and treatment of ocular disorders. The qualitative and quantitative change in different

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components of the retinal layer in cases of myopia has been a subject of different studies but to the best of our knowledge, these changes have not been studied in myopic eyes with lattice degeneration (ME-LD). In this study, we assessed MT, GCL, and RNFL in ME and LD in comparison to emmetropic eyes with the help of Cirrus HD OCT 5000 (Carl Zeiss Meditec Inc., Dublin, CA).

METHODS

It was a hospital-based, nonrandomized, prospective observational study conducted in accordance with the principles of the Declaration of Helsinki after getting approval from the institutional review board.

The study group included the equal number of individuals between 20 and 40 years of age with emmetropia, myopia, and ME-LD with refractive error of − 3−−6 D. Individuals with any other ocular or systemic pathology, prior history of ocular surgery or long term ocular medication affecting optic nerve head or RNFL thickness were excluded from the study. Individuals with media opacity affecting OCT analysis were also excluded.

Ninety eyes of 101 individuals between 20 and 40 years of age were included in the study. Patients <20 years were excluded as the normative database is not available in Cirrus HD OCT for individuals <18 years of age. The study population was divided into three groups – Group A with 30 eyes having the mean myopic spherical equivalent of −4.01 ± 1.79 Diopter, Group B with 30 ME-LD having the mean spherical equivalent of −4.6 ± 1.82 diopter, and Group C having 30 emmetropic eyes with spherical equivalent ±0.5D. The best-corrected visual acuity was 6/6 in all three groups on Snellen's visual acuity chart. All patients underwent comprehensive eye evaluation including cycloplegic refraction, slit-lamp examination, intraocular pressure measurement with applanation tonometry, pachymetry evaluation with Cirrus OCT, gonioscopy, and dilated fundus evaluation with indirect ophthalmoscopy.

OCT scan was performed under mydriasis with Cirrus high-definition (HD) OCT5000 (Carl Zeiss Meditec Inc., Dublin, CA, USA) which has an axial resolution of 5 microns and a scan speed of 27,000 A-scans per second. All the scans had signal strength of 6 or more, well centered over disc or macula and were done by single experienced operator. MT was assessed in a macular cube (512 × 128) consisting of 9 sectors of the early treatment diabetic retinopathy study grid from the internal limited membrane to retinal pigment epithelium. For the ease of calculation, only central subfield and the 4 surrounding Parafoveal inner sectors; inferior, superior, nasal, and temporal (I-S-N-T) were considered while evaluating the results. The outer 4 sectors were not considered in the evaluation. GCL analysis was done in macular cube protocol and is shown as average and minimum GCL + inner plexiform layer (IPL) thickness. In addition, the I-S-N (average of supero + infero-nasal)-T (average of supero + infero-temporal) GCL + IPL thickness were also considered in the calculation. RNFL thickness was assessed in 6 mm × 6 mm optic disc area (200 × 200) and average and thickness in I-S-N-T quadrants were evaluated.

Statistical analysis was done using unpaired two-tailed *t*-test and $P < 0.05$ was considered significant.

RESULTS

The three study groups were age matched. The mean age of Group A (myopia) was 30.8 ± 6.24 years, of Group B (ME-LD) was 25.5 ± 4.68 years and of Group C (emmetropia) was 28.9 ± 7.23 years. The mean myopic spherical equivalent of Group A, B and C was − 4.01 ± 1.79D, −4.6 ± 1.82D, and ± 0.5D, respectively Table 1.

The average RNFL thickness of Group A (Myopia), B (ME-LD), and C (Emmetropia) was 84.73 µ ±8.68 µ, 86.30u ± 8.72 µ and 93.26 ± 8.61 µ respectively. The average RNFL thickness was higher in Group C as compared to Group A and B. The statistical difference between average RNFL thickness of Group A and B was not significant ($P = -0.488$) but there was a significant difference in thickness of average RNFL between Group C than those with Group A ($P = <0.001$) and B ($P = 0.002$) Figure 1.

The quadrant-wise comparison of RNFL thickness in I-S-N-T quadrants was performed among three groups. The statistical analysis showed a significant difference between Group C, than Group A and B in superior ($P = -0.028$, 0.048 respectively) and inferior quadrant ($P = -0.007$, 0.033, respectively) but not in nasal and temporal quadrant. There was no significant difference between Group A and B in any of the quadrants.

The MT of central subfield of Group C was lesser (227.10 ± 13.08u) than Group A (249.30 ± 20.24u) and Group B (243.60 ± 28.12). The statistical difference was highly significant between Group C in comparison to Group A ($P < 0.001$) and B ($P = 0.005$) but not between Group A and B ($P = 0.371$) Figure 2.

Table 1: Comparison of the thickness of macula, ganglion cell layer, and retinal nerve fiber layer in emmetropes, myopes and myopes with lattice degeneration

Parameter	Emmetropia versus myopia	Emmetropia versus ME-LD	Myopia Versus ME-LD
Average RNFL thickness	Significant ($P<0.001$)	Significant (P – 0.002)	NS (P – 0.488)
I-S-N-T RNFL thickness	Significant in superior (P – 0.028) and inferior quadrant (P – 0.007)	Significant in superior (P – 0.048) and inferior quadrant (P – 0.033)	NS
Central macular thickness	Significant ($P<0.001$)	Significant (P – 0.005)	NS (P – 0.371)
I-S-N-T parafoveal thickness	NS	NS	NS
GCL+IPL thickness - average and minimum	Significant ($P<0.001$ and 0.025)	Significant (P – 0.001 and 0.002)	NS (P – 0.910 and 0.072)
I-S-N-T GCL+IPL thickness	Significant in all quadrants	Significant in all except temporal quadrant (P – 0.420)	NS

ME-LD – Myopic eyes with lattice degeneration, RNFL – Retinal nerve fiber layer, I-S-N-T – Inferior-superior-nasal-temporal, GCL – Ganglion cell layer, IPL – Inner plexiform layer, NS – Not significant

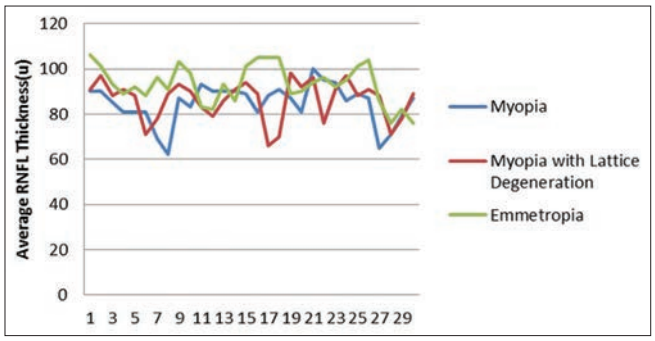


Figure 1: Average RNFL thickness in three groups

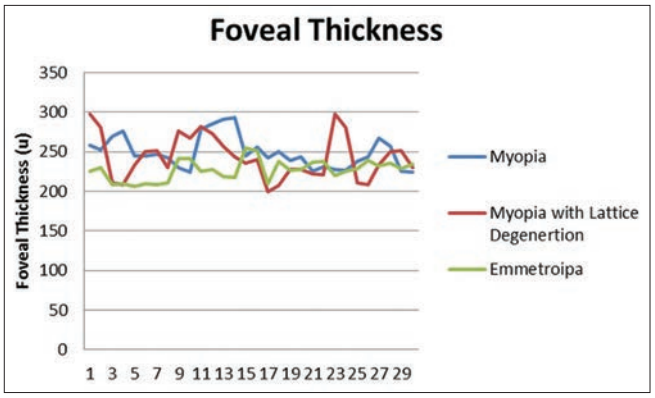


Figure 2: Central macular thickness in three groups

None of the inner Parafoveal segments of any group has any significant difference from each other in any of the quadrants.

The average and minimum GCL + IPL thickness was higher in Group C (82.3 ± 4.66 μ and 78.1 ± 9.44 μ) than Group A (77.2 ± 5.17 μ and 72.9 ± 8.07 μ) and B (77.4 ± 6.17 μ and 66.4 ± 17.3 μ). The difference in average and minimum GCL + IPL thickness was significantly higher in Group C than Group A ($P < 0.001$ and 0.025, respectively) and B ($P = –0.001$ and 0.002, respectively). There was no significant difference between Group A and B ($P = –0.910$ and 0.072, respectively) Figure 3.

On comparison of GCL + IPL thickness in different quadrants, it was significantly different in every quadrant between Group A and C. On comparison of Group C and Group B, it was significantly different in all except temporal quadrant ($P = –0.420$). It was not significant in any quadrant between Group A and B.

DISCUSSION

Myopia is one among the most common ocular pathology worldwide and LD is an important vitreoretinal fundus change seen in ME. The prevalence of LD in the general population is about 7%–11%.[3] The primary basic pathogenesis behind LD has not been completely understood. The proposed theories are the regional developmental absence of the internal limiting membrane with defects in the fibers of the Müller's cells and abnormal vitreoretinal traction dynamics.[4] Histological characteristic of LD are retinal thinning, vitreous liquefaction, vitreous adhesion at lattice margins, vascular changes, retinal pigment abnormalities, and accumulations of dense amorphous material.[5] All these changes become more progressive toward the center of lesion.

RNFL thinning in myopes has been related to elongation and thinning of retina and sclera, which would spread the nerve fibers over a large surface area.[6] In ME it has been reported that there is a temporal convergence of superotemporal and inferotemporal RNFL bundles with increasing myopia, leading to abnormal RNFL measurement.[7]

Although Hoh *et al*.[8] reported no correlation between RNFL thickness and refractive status of an individual, the average RNFL thickness in our study was significantly higher in emmetropic eyes (93.26 ± 8.61 μ) than myopes (84.73u ± 8.68 μ $P < 0.001$)) and in ME-LD (86.30 μ ± 8.72 μ $P = –0.002$). ME had slightly higher average RNFL thickness than ME-LD eyes, but the difference was not significant. This difference in results from that published by Hoh *et al*. can be due to different OCT machines

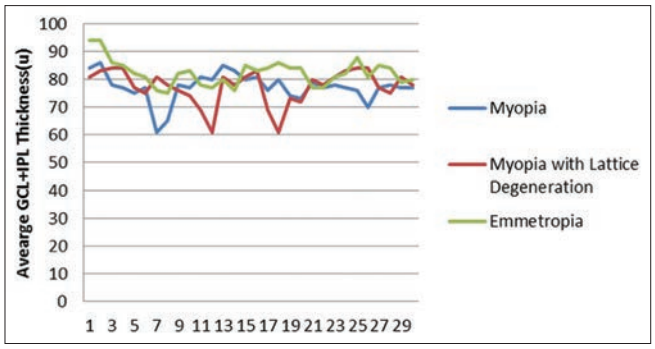


Figure 3: Average ganglion cell layer + ganglion cell layer thickness in three groups

used in these two studies (OCT 1, version 4.1 versus Cirrus HD OCT). Tai *et al*. in their Zeiss Cirrus HD-OCT-based study compared the RNFL thickness in 180 emmetropic eyes and 223 ME with different grades of myopic refractive error and reported thinner RNFL in all groups of myopia than in emmetropes.[9] In a spectral-domain OCT-based study by Oner *et al*., the average RNFL thickness was again higher in emmetropes than myopes.[10] Similar report has been published by Zha *et al*. in their study on 271 Chinese participants comparing the RNFL thickness with Spectralis OCT, among emmetropes and different grades of myopes. They demonstrated that ME had a thinner average global RNFL thickness compared with emmetropic eyes, while the high myopic eye had the thinnest average global RNFL thickness.[11] A contradictory result of thicker RNFL in myopes than age-matched healthy individuals has been reported by Bozkurt *et al*. in their study based on GDx. This study included 41 degenerative ME of 25 patients with spherical refractive errors between −7.50 and −22.00D (mean − 12.5 ± 3.5D).[12] This discrepancy was attributed to the high scleral rigidity as a result of peripapillary chorioretinal atrophy associated with high myopia, leading to an apparent increase in retardation values.[6]

In our study, the evaluation of RNFL thickness in I-S-N-T segments showed significant difference between emmetropes and myopes/ME-LD only in superior and inferior quadrants but not in nasal or temporal quadrants. A similar report has been published by Rauscher *et al*. in their study of myopic individuals between 23 and 54 years of age with mean spherical equivalent of –5.40 D. The nasal and temporal RNFL thickness in their study showed no significant association with myopia.[13] Another study based on Cirrus OCT by Kang *et al*., in a Korean study population of 269 subjects between 19 and 26 years of age, with mean spherical equivalent of –2.5 ± 2.29 D, reported that with increase in myopia and axial length, there is decrease in superior and inferior peripapillary RNFL thickness and increase in temporal RNFL thickness. In myopic subjects, the measured RNFL thickness may be less than the actual thickness, and owing to the temporal shift in the contour of the RNFL thickness profile, the superior and inferior RNFL may be deemed abnormal in comparison with the normative reference provided by Cirrus OCT. He suggested to avoid such misdiagnosis, a new normative RNFL profile for myopic patients is needed.[14] Oner *et al*. based on RTvue standard deviation OCT comparing myopic and emmetropic individuals reported that average RNFL thickness and the RNFL thicknesses of the superotemporal, superonasal, inferotemporal, and lower temporal sectors were significantly different between the myopic and emmetropic eyes.[10]

In their Cirrus OCT-based study, Tai *et al*. also has also published myopic group having thinner average RNFL than the emmetropic group and their RNFL was thinner in all quadrants except temporally.[9] An Indian study on 118 ME of patients between 20 and 30 years of age by Kamath *et al*., has reported a significant decrease in average RNFL thickness in all quadrants except the temporal quadrant. They speculated that the insignificant change in the temporal quadrant might be due to the dragging of the retina toward temporal horizon and compression of bundles originating from the opposite hemisphere at the horizontal raphe, causing thinning of RNFL thickness in all quadrants except temporal. The decrease in RNFL thickness was lesser in nasal quadrants than in other quadrants.[15]

Various conflicting results have been published on the association between refractive error and central MT. The study by Ooto *et al*.[16] and Manassakorn *et al*.[17] have reported no association between MT and myopia or other refractive error. Huynhet al have published thicker central MT in hyperopes in their study on the younger population of 6-year-old children. But this study was done on the Caucasian race and on an age group which is still is in the age of emmetropization.[18] The MT in our study was lesser in emmetropes than in myopes or in ME-LD. There was a significant difference between emmetropes and in these two groups but not between myopes and ME-LD.

Similar result has been published by Lim *et al*. based on their study on 130 Asian myopic (–0.25—14.25D) individuals between 19 and 24 years. They reported myopics having thinner parafovea and thicker fovea.[19] Yau *et al*. in their study of the Chinese population of 168 eyes between 4 and 18 years of age reported that the central MT was significantly higher in myopics than the emmetropic group.[20] The study by Wakitani *et al*. showed higher central MT in ME where it serves as compensatory mechanism at the expense of a

thinner peripheral retina in order to preserve the fovea, which is more essential to vision.[21]

None of the inner segments of any group has any significant difference from each other in any of the quadrant which is similar to result published by Samuel *et al*. who reported a significantly thicker fovea with decrease in spherical equivalent but no significant change in parafoveal MT with decrease in spherical equivalent. They have mentioned that increase in the axial length of myopia causes mechanical stretching of the sclera in the posterior pole. This causes traction of vitreous on the fovea in the ME. Thus the increase in the foveal thickening with increasing degree of myopia can be an early sign of vitreoretinal traction.[22]

Since ganglion cell loss precedes RNFL loss in disorders like glaucoma, it may be useful to do ganglion cell analysis for early detection of disease.[23] The average and minimal GCL + IPL thickness in our study was significantly different between myopes and emmetropes. On comparing GCL + IPL thickness in I-S-N-T segments in these two groups, the difference was again significant in all the quadrants. In one of the Cirrus OCT-based study conducted by Seo *et al*. on a population of similar age group (20–32 years) and refractive error (Mean spherical equivalent-3.58 ± 2.74 diopters), there was a decrease in GCL + IPL thickness noted with increasing myopia in all the sectors.[24]

Study by Szumiński and Bakunowicz-Łazarczyk has also reported significantly lower GCL thickness in the superior and inferior quadrant in the population of high myopes of >6D of refractive error, in comparison to emmetropes.[25] Zhao *et al*. has also stated significant relationship between refractive error and GCL thickness and the importance of considering the refractive status of person before going for GCL analysis.[26]

In our study when we compared quadrantic GCL + IPL thickness between emmetropes and ME-LD, it was significantly higher in emmetropes in all quadrants except the temporal. The difference in GCL + IPL thickness between myopics and ME-LD was not significant.

We could not find studies based on the assessment of the thickness of macula, RNFL and GCL in ME-LD. However, the present study has got certain limitations like relatively small study population. Another potential source of error in measurement is using the same size scan circle (i.e., 1.7 mm) in different grades of myopia. At present, the normative database of Cirrus HD OCT is based on the mean refractive error of –0.82(±1.96) D.[27] One needs to add a correction factor depending on the axial length of the myopic eye as reported by Kang *et al*.[14] We tried to negate this error by choosing patients between −3 and −6D of myopia in both the myopic groups so that the difference in axial length does not play a large role here.

CONCLUSION

There was a significant change in studied OCT parameters between emmetropes when compared with myopes/ME-LD. However, myopes and ME-LD showed no significant difference. This underscores the need of incorporating a myopic normative database in the present normative built-up of Cirrus OCT.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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Original Article

Role of teachers in screening of ocular disorders in school children: A multistage school screening program

ABSTRACT

Purpose: The aim of the study was to find out whether teachers can be introduced as an effective tool in ocular screening of school children and to list out various causes of visual impairment and ocular abnormalities in school children and provide appropriate measures. **Method:** A multistage school screening program from August to December 2019 in Trivandrum included 33,990 students from 52 schools. Five stages of the study were training of selected teachers, screening by teachers in the school, comprehensive examination by the hospital team in schools, detailed evaluation of referred children in the hospital, and corrective measures by pediatric ophthalmologists in our hospital. A total of 1480 children were selected randomly from the children identified as normal by teachers to detect false negatives. The pattern of ocular disorders children was analyzed. **Results:** Out of 33,990 students, 6343 students who were detected to have ocular disorders by teachers (18.6%) were examined by our team. 74.2% (4707 students) of them were confirmed to have ocular problems. Thus teachers were able to identify the eye problems correctly (true positives) in 74.2% children, 25.8% being false positives. True positives include refractive errors (73.4%), allergic conjunctivitis (7.9%), strabismus (1.9%), amblyopia (0.098%), pediatric cataract (0.08%), etc. Out of 1480 randomly selected children, 8 (0.54%) children were false negatives (none had refractive errors). Spectacles were given to 2484 children free of cost. **Conclusion:** Simplicity of multistage screening, ease of its application, time and cost effectiveness, wider coverage, utility as a continuous process in coming years signifies that introducing teachers as primary vision screeners at their schools is an innovative community-based strategy to address the challenges of childhood blindness in resource-constrained settings.

Keywords: Childhood blindness, refractive errors, school screening

INTRODUCTION

Childhood blindness is one of the priority targets of Vision 2020-Right To Sight due to its impact on the overall development of the child. The WHO reports that there are approximately 19 million visually impaired children in the world, and 1.4 million are blind.[1] The overall population-based estimate of prevalence of refractive errors in children in India was 8%, and from the school-based data, it was 10.8%.[2]

Childhood blindness due to various preventable causes suggests that eyecare services in the population are inadequate. Vision screening of children in schools has traditionally been done by optometrists and ophthalmologists. In most developed countries, the optometrist-to-population ratio is approximately 1:10,000. However, in developing countries, the ratio is 1:600,000 and much worse in many rural areas, up to millions.[3] In rural areas of India, only 10,000 ophthalmologists are responsible for the care of the entire population: a ratio of 1 ophthalmologist per 100,000 people.[4] This lack of practitioners is the main reason for high rates of vision problems due to uncorrected refractive error in developing countries.

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Introducing teachers in school eye screening programs, especially in rural areas, can lead to effective utilization of existing resources and early detection of potentially blinding disorders in children. It will save enormous amount of time and energy of the eyecare staff, reduce their workload, and provide a wider coverage of eyecare services. This model is low-cost and has been successfully tried in parts of India, China, and Brazil.[5] It is important to know the accuracy of the screening carried out by teachers before recommending this method as an effective tool.

AIMS AND OBJECTIVES

1. To find out whether teachers can be introduced as an effective tool in ocular screening of school children.
2. To list out various causes of visual impairment and ocular abnormalities in school children and provide appropriate measures.

MATERIALS AND METHODS

This study was a prospective multistaged clinical trial carried out over a period of 5 months from August to December 2019 in Trivandrum district, Kerala. This study included 33,990 students from 52 schools in the age of 5–15 years. The study was approved by the institutional ethics committee and followed the tenets of the Declaration of Helsinki for biomedical research. As a preparatory step, a school screening team comprising a project director, pediatric ophthalmologist, general ophthalmologist, staff nurse, optometrists, public relation officer (PRO), and camp coordinator was formed.

Trivandrum district is divided into 3 educational districts including Trivandrum, Attingal, and Neyyattinkara. Details of schools in each educational district were collected from the corresponding district educational officers. After necessary planning, the camp coordinator and PROs visited each school to brief the headmaster about the program. Following the visit, teachers willing and able to participate in the program were identified depending upon the total number of students in that school for training. The school authorities provided consent for eye examination by optometrists in their premises.

The study was done in 5 stages:
Stage 1: Training of selected school teachers

Stage 2: Screening by the trained school teachers in the school

Stage 3: Vision testing by optometrists and comprehensive ophthalmological evaluation by general ophthalmologists in the school

Stage 4: Cycloplegic refraction and detailed ophthalmologist examination in the secondary eye center for referred children

Stage 5: Surgery and visual rehabilitation by pediatric ophthalmologists in the tertiary eye center

Training of selected school teachers

273 school teachers from 52 schools in Trivandrum were invited to the training program arranged with the help of the NGO Lions Club. A total of 7 teacher's training programs, each of half-day duration, were conducted. The training was given by ophthalmologists and optometrists.

The lectures started with topics on magnitude of childhood blindness and the role of teachers in early detection of vision problems. The first half of the training program was devoted to an introduction to the anatomy and functioning of the eye and common eye problems in children. Slides, posters, and videos were presented in addition to didactic lectures. The second part of the program included practical training on how to measure visual acuity using Snellen's chart. This was practiced by the teachers among themselves.

Subsequently, each teacher repeated the whole procedure in front of the staff in order to confirm that they understood the procedure completely and also to clear their doubts. The school teachers were provided with a Snellen's number chart, a rope of 6 meters to measure the distance, and a form to fill in the details of the child including short history.

Screening by teachers

Children were asked to read the number pointed out by the teacher on the Snellen's chart from a distance of 6 meters. Children with any other ocular abnormalities or children complaining of ocular symptoms were also selected for further stages of the study.

Screening by the hospital team

On another day, within 1 month after teacher screening was completed, the hospital team screened the children selected by teachers. Six optometrists with >5 years of experience were included for the study. All children underwent vision screening by the optometrists and comprehensive examination by the ophthalmologist.

Those who were detected to have refractive error were referred to the hospital for dilated retinoscopy and fundus examination. Children with common problems such as blepharitis, allergic conjunctivitis hordeolum, etc., were give medications in the camp site. Those who needed further evaluation for cataract, ptosis, asthenopic symptoms for

convergence evaluation, squint for orthoptic evaluation, etc., were also referred.

To assess the true negatives and false negatives, we conducted the second part of the screening. Approximately 5% of children who were identified as normal by the school teachers were included for examination by the ophthalmology team. These children were identified using a simple random sampling technique. Children identified as normal by the teacher but found to have abnormalities by the ophthalmology team were considered as false negatives. The data analysis was done using MS-Office Excel.

RESULTS

In the first stage of the project, 52 schools in Trivandrum district were covered. A total of 273 teachers from these schools were trained in vision screening. The project enrolled 34,274 school-going children in the age of 5–15 years. Out of these, 33,990 children (51.3% males and 49.7% females) were screened by the teachers, providing a coverage of 99.1%. They were divided into 3 categories as lower primary school (LPS, $n = 8579$), upper primary school (UPS, $n = 7431$), and high school (HS, $n = 17980$).

The teachers identified 6343 (18.6%) children with eye problems, who needed evaluation by an ophthalmologist. These included 24.81% LPS, 21.2% UPS, and 53.94% HS children (males 46.8%, females 53.2%). Therefore, our team had to examine only 18.6% of the total children enrolled in the project [Figure 1].

The team confirmed eye problems in 4707 children (13.8% of the total children enrolled for the study). Thus, the teachers were able to identify the eye problems correctly (signifying true positives) in 74.2% children, remaining 25.8% being false positives [Figure 2].

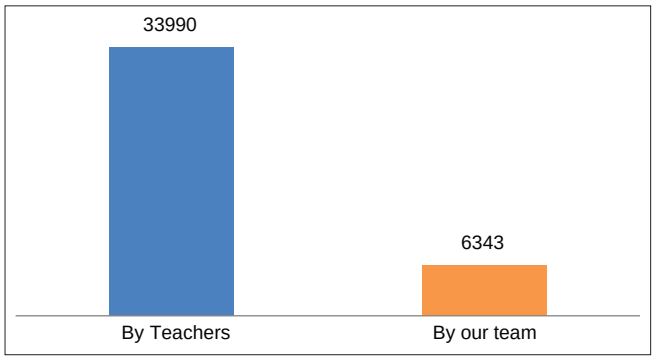


Figure 1: Comparison of the number of children examined by teachers and the hospital team

Out of the 4707 children identified as true positives, ocular disorders among various categories were 68.5% in LPS, 78% in UPS, and 69.6% in HS children.

Out of 33,990 children, 4.35% ($n = 1480$) who were identified as normal by the school teachers were selected by a simple random sampling technique and re-examined by the hospital team. 8 children (0.54%) were found to have eye problems (3 blepharitis, 1 chalazion, 1 ADS, 1 corneal opacity, 1 mild ptosis, and 1 nystagmus) [Figure 3]. None of them had refractive errors.

Most common presenting complaints were defective vision (15.4%), eye strain with glasses (13.4%), and headache (8.9%). Other complaints were pain, watering, floaters, lid swelling, deviation of eyes, etc [Table 1].

Simple myopic astigmatism was the most common refractive error (37.2%), followed by myopia (24%) and compound myopic astigmatism (19%).

Out of 4707 children diagnosed to have ocular disorders, treatment was given for conditions such as hordeolum, blepharitis, etc., and 235 were disposed in the camp. 4472 children were referred to tertiary care centers. Spectacle correction was given free of cost to 2484 children having significant refractive errors (87.9% were not using spectacles previously) [Table 2].

DISCUSSION

Although the simplicity of vision screening by teachers has resulted in its wide coverage and acceptability, there is scanty literature available about the accuracy of the teachers in picking up subnormal vision and comparing it with a trained eyecare worker.

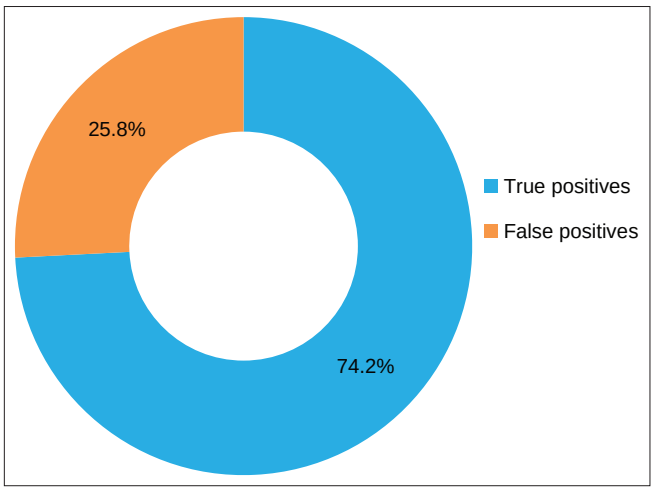


Figure 2: Children identified as true positives and false positives after examination by the hospital team in stage 3 of the program

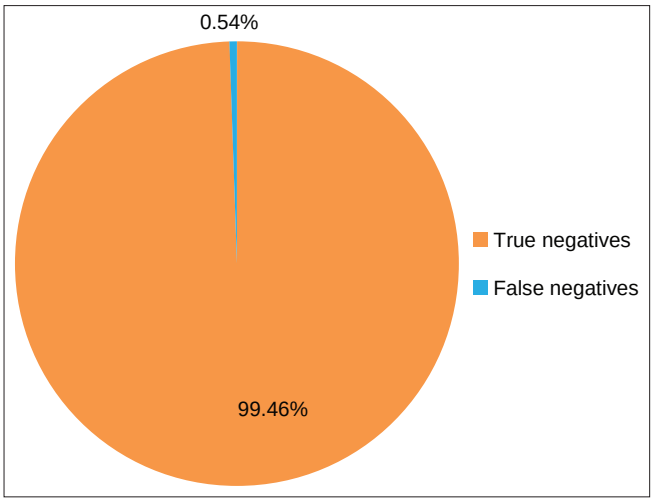


Figure 3: Children identified as true negatives and false negatives after examination by the hospital team

In our study, teachers were able to cover 99.1% of enrolled population, which indicates the organization of the entire program and the ability to involve schools and teachers, the benchmark being 80–100% that had been given by Limburg *et al*.[6]

In this study, the ophthalmologist had to examine only 18.6% of the total children. On an average, each teacher screened about 125 children in a year and referred about 23 children for further evaluation. Presuming that it takes 5 minutes to screen a child, each teacher is estimated to have spent 9–10 hours in a year to screen children with an additional 8 hours spent for training. This accounts to less than 18 hours in a year. On the other hand, the workload of the hospital team reduced significantly. Therefore, this method effectively utilizes time and manpower.

The effectiveness of the school screening program was assessed by the true positives, false positives, true negatives, and false negatives. In our study, 74.2% children were identified as true positives, with considerably higher sensitivity than similar studies.[7–9]

The false-positive rate in this program (25.8%) was comparatively lower than those in similar studies [Table 3], but it indicates that nearly a quarter of the referrals to the ophthalmology team were unnecessary as they had to screen these children when actually they did not need any screening. This can be sorted out by improving the quality of teacher's training, making them more confident. The over-diagnosis by the teachers may also be acceptable as this ensures that the teachers are trying to avoid missing out any child because of their doubts.

Table 1: Common ocular disorders identified in the true positives

Refractive errors: 3455	Nystagmus: 2
Allergic conjunctivitis: 372	Blepharitis: 27
Strabismus: 92	Chalazion and hordeolum: 4
Amblyopia: 41	Ptosis: 3
Developmental cataract: 4	Choroiditis scar: 1
Convergence insufficiency: 12	CHRPE: 1
Lattice degeneration: 4	WWOP: 2
Malingering: 27	Cavernous hemangioma (Sturge Weber syndrome): 1

Table 2: Various methods of management of true-positive children are given

Spectacles: 2484	Cataract surgery: 1
Barrage laser: 4	Cat card exercise: 12
Patching for amblyopia: 38	ENT consultation for sinusitis: 2
Squint surgery: 1	Pediatric consultation: 4
I&C: 1	Medications for conjunctivitis, blepharitis, etc.

The study by Muralidhar *et al*.[5] showed that teacher vision screening had a low sensitivity of 24.8% in primary school children due to limited time devoted to teacher training, failure to standardize various factors such as time devoted per student by the teacher, and lack of written protocols for teachers.

The low false-negative rate in the project (0.54%) is reasonably good, supporting the premise that teachers were referring only when they were sure that the child was normal. The false-negative rate is important as it indicates the quality of training to teachers. The disorders which were missed by teachers were mild conditions, and none of them had refractive error.

One study assessed the accuracy of school nurse screening of 1719 students in Oman[11] reporting a sensitivity of 68% and a specificity 99%. School nurses, although more affordable than ophthalmic personnel, are less commonly available for screening than teachers.

Priya *et al*.[12] compared selected teachers (STs) to all class teachers (ACTs) and found that screening with classroom teachers identified significantly more ocular conditions, other than refractive error. The ACT model significantly increased the number of children attending follow up compared to the ST model as ACTs had the maximum interaction with students in their class.

The prevalence of refractive errors among younger school children in the present study was 10%, which lies in the mid-range (1.8–23%) reported in previous studies.[13] Uncorrected refractive errors were high in the study, and only 11.8% of children were wearing glasses similar to

Table 3: Comparison of our study with the previous studies

Studies	Our study 2019	Gurvinder[10] 2016	Sexana[8] 2015	Sedan[7] 2009	Limburg[6] 1999
No. of schools covered	53	166	530	20	32848
No. of teachers trained	273	253	530	40	32848
No. of students enrolled	34,274	30,298	77,778	10,114	5,389,065
% examined by teachers	99.1%	99.7%	88.50%	97.3%	-
% of children referred by teachers	18.6%	14.97%	4.91%	17.3%	4.3%
True positives	74.2%	47.25%	42.03%	67.02%	26.5%
False positives	25.8%	52.75%	57.97%	32.98%	73.50%
True negatives	99.46%	-	93.92%	96.33%	-
False negatives	0.54%	-	6.08%	3.67%	-

those reported by Rewri *et al*.,[14] which necessitates regular screening in children. The prevalence of other disorders was comparable to other studies.[13,15]

CONCLUSION

Simplicity of multistage screening, ease of its application, time and cost effectiveness, wider coverage, and utility as a continuous process in coming years signifies that introducing teachers as primary vision screeners at their schools is an innovative community-based strategy to address the challenges of childhood blindness in resource-constrained settings.

It would also be more effective in motivating the children for subsequent follow up, regular use of glasses, and monitor the impact of treatment on their performance in studies. The observation that none of the children with ametropia were missed by the teachers in this project shows that the teachers can effectively perform vision screening of children.

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Outcome of cataract surgery with 1 h of preoperative antibiotic regimen: A strategy during COVID-19 Pandemic: Study from a tertiary eye care hospital

ABSTRACT

Purpose: This study aims to describe the visual and surgical outcomes of 810 eyes of 805 patients who underwent unilateral cataract surgery on the same day with 1 h of preoperative antibiotic regimen. **Setting:** Tertiary Care Ophthalmic Hospital. **Design:** Retrospective, descriptive study. **Methods:** This study comprised of consecutive adult patients who underwent preoperative cataract work up, received 1 h of preoperative antibiotic regimen, and underwent cataract surgery on the same day of consultation with a minimum 3-week follow-up period. This study describes the demographic profile, preoperative, intraoperative details, postoperative (PO) best-corrected visual acuity (BCVA), and surgical outcomes of these patients. **Results:** 810 eyes of 805 patients with a mean age of 61.0 ± 9.7 years, 50% had systemic and 9% had ocular comorbidities. The mean preoperative BCVA was 0.8 ± 0.7 LogMAR. Phacoemulsification was performed in 90.1%. Intraoperative complications had occurred in 8 (1%) eyes. The mean PO BCVA of the study group on PO day 1 (POD1) and PO 3 weeks was 0.13 ± 0.3 LogMAR and 0.07 ± 0.3 LogMAR, respectively. Our study showed that 95.68% had improvement in vision, while 96.8% achieved BCVA 6/18 or better. None had PO endophthalmitis. Comparison between preoperative and both POD 1 day and PO 3-week BCVA showed statistically significant improvement ($P < 0.001$). **Conclusion:** Our study results satisfied the benchmark set by the World Health Organization (WHO) for PO BCVA with good surgical outcome. Preoperative antibiotic applied 1 h before cataract surgery provided safety and comfort and with low risk for endophthalmitis. This strategy can be adopted to tackle the backlog of cataract surgeries due to COVID-19 (or any other emergency situation) in developing countries.

Keywords: 1 hr preoperative antibiotic regimen, cataract surgery, COVID-19 pandemic, surgical outcome, visual outcome

INTRODUCTION

The leading cause of blindness globally is cataract (17.01 million).[1] Cataract surgery is the second most common surgical procedure after cesarean section. The global median cataract surgical rate was 1700 per million population per year during the past decade.[1] India has achieved high cataract surgical coverage of nearly 6.5 million surgeries every year with an average rate of more than 5000 surgeries per million population per year.[2] It is known that the majority of cataract surgeries are being performed by the nongovernmental sector. Yet, the backlog of cataract surgery in India is enormous. In 2019, the blindness in population aged ≥50 years in India due to untreated cataract was reported to be 62.2%.[3] The "*Lancet Global Health* Commission on Global Eye Health: Vision beyond 2020" had estimated, worldwide, 596 million people

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with distance vision impairment, of whom 43 million were blind and a large proportion of those affected (39.62 million; 91.75%) live in low-income and middle-income countries. Furthermore, the largest number of blind people lived in South Asia.[1,4]

Over the years, cataract surgical service in a developing country such as India has undergone a dramatic adaptation to provide patient convenience. At present, the standard approach to treat cataracts is "Delayed Sequential Bilateral Cataract Surgery." There is a wide variability in the antibiotic agents used (fluoroquinolone versus aminoglycoside, or cephalosporin, or chloramphenicol), the administration routes (topical, intraocular, subconjunctival, or oral), and the timing (preoperative, intraoperative, or postoperative [PO]).[5] The rationale behind their use is that antibiotic levels exceeding the minimal inhibitory concentrations required to inhibit bacterial growth in the aqueous humor would lower the risk of intraocular contamination either intraoperatively or postoperatively.[6]

The vast majority of respondents in the survey carried out among the ophthalmologist members of the All India Ophthalmological Society, 90% ($n = 1109$), used perioperative topical antibiotics for cataract surgery.[7] In clinical practice, topical antibiotics are commonly used 1 or 3 days before cataract surgery.[8,9] The ESCRS published guidelines recommend the use of a topical quinolone four times a day for 24 or 48 h before surgery and additional instillations of one drop, 1 h and 0.5 h before operation.[10]

Since the beginning of COVID-19 pandemic in India, there has been a drastic reduction in elective cataract surgeries.[11,12] Lockdown measures led to a poor health-seeking behavior. The evolving guidelines provided by the Government of India in the mid-2020 regarding the performance of safe cataract surgery (focused on the safety for the operating teams and patients) led to the restarting of cataract surgeries.[11,12] In comparison to the corresponding period of the previous year, the number of cataract surgeries had declined drastically by 99.7%.[12] To tackle the huge surge in the number of patients presenting to the hospitals after lifting of the lockdown, it was recommended to change the functioning of hospitals to prevent crumbling of the health-care system.[12,13] Unlike other surgical disciplines that might be more reliant on expansive resources such as intensive care and inpatient hospitalization, it might be possible to ramp-up operations in ophthalmology due to the predominantly outpatient nature of surgeries.[14]

To handle the critical situation during the COVID-19 pandemic at our tertiary care center, one of the strategies proposed was to perform same-day unilateral cataract surgery with 1 h of preoperative antibiotics. These was planned without compromising on the preoperative preparation, intraoperative, or PO patient care. This study aims to describe the visual and surgical outcomes of such patients.

METHODS

This is a retrospective, descriptive study done among 810 eyes of 805 consecutive eligible adult patients. Eligible patients were defined as those who underwent cataract evaluation, preoperative preparation, received preoperative antibiotics and applied it for a duration of 1 h before surgery, underwent cataract surgery on the same day and were discharged either on the same day or the next day morning. Patients who had uncontrolled systemic ailments requiring specialist evaluation and requiring anticoagulants to be stopped before cataract surgery were not advised to undergo cataract surgery on the same day. The study was approved by the institutional Ethics Committee and has adhered to the tenets of the Declaration of Helsinki. Informed consent was obtained from all patients.

Preoperative cataract surgery evaluation

All patients underwent vision, retinoscopy, slit-lamp biomicroscopy, intraocular pressure (IOP) (using noncontact tonometry method), fundus evaluation or ultrasonogram B-scan (hazy media due to dense cataract), and biometry. Eligible patients were identified and a dedicated team that included a doctor, clinical manager, ophthalmic technician, counselor, and nurse was responsible for fast tracking these patients to avoid delay or breach in protocol. Patients underwent counseling for selection of the intraocular lens. Systemic evaluation including random blood sugar, blood pressure measurement, body temperature, blood oxygen saturation, and electrocardiogram (for needed patients) was performed.

Preoperative cataract surgery preparation

All patients received preoperative antibiotic eye drop (E/D) ofloxacin 0.3% (Auroflox, Aurolab, India) 1 h before cataract surgery, applied 6 times every 10 min. Just before the surgery, E/D povidone–iodine 5% (Aurodone, Aurolab, India) was applied in the conjunctival cul-de-sac in the Block Room, and also on the operating table before preparation for surgery, and at the end of surgery before placing the eye patch. Periocular skin disinfection on the operating side was done with 10% povidone-iodine (Aurodone-DS, Aurolab, India) once in the Block Room and once again on the table before draping the patient's face. At the end of surgery, all patients received injection of 0.1 cc of intracameral (IC) moxifloxacin (Auromox, Aurolab, India). Cleaning, disinfection protocols, personal protective equipment usage for the patients' health-care providers and for the operating team

were followed as per the guidelines.[11] Separate operating team with sterilized instruments, operating sets, linen, and surgical material were used for these patients. All patients were discharged immediately after their surgery (except for admitted patients who needed overnight hospital stay, for whom next day PO vision and a slit-lamp biomicroscopy was performed before discharge). The daycare patients (those who were discharged on the same day of surgery) were reviewed the next morning and evaluated similarly on an outpatient basis. Patients were started on PO medications which included E/D ofloxacin 0.3% (Auroflox, Aurolab, India) four times a day for 1 week and E/D dexamethasone sodium phosphate 0.1% (Dexa, Aurolab, India) four times a day for 1 week, tapered over 4 weeks. Patients were reviewed after 3 weeks. During the PO 3 weeks (PO 3 weeks) visit vision, retinoscopy, IOP, slit-lamp biomicroscopy, and dilated fundus evaluation were performed.

Data collection

The details of 810 eyes of 805 patients fulfilling the selection criteria were retrospectively collected from the electronic medical records of the institution database. The patient demographic details such as age, sex, locality, comorbidities, preoperative evaluation details including preoperative best-corrected visual acuity (BCVA), type of cataract, biometry details (axial length and keratometry), and IOP were recorded. The intraoperative parameters included were the type of anesthesia, type of cataract surgery performed, intraoperative complications, IOL power and design implanted for the patient, and the BCVA on PO day 1 (POD1), PO 3 weeks. The WHO definition was used to categorize BCVA: blindness was defined as VA <3/60, 5/60–3/60 as severe visual impairment, 6/24–6/60 as visual impairment, and 6/6–6/18 as NORMAL vision.[15] PO details including the incidence of endophthalmitis on POD1 and PO 3 weeks were noted.

Inclusion and exclusion criteria for the study

All adult patients aged between 18 and 85 years undergoing cataract surgery with IOL implantation on the same day between October 2020 and January 2021 with a minimum 3-week follow-up were included, while patients with insufficient follow-up were excluded.

Statistical analysis

Data were entered using Google Forms, stored in excel, and were analyzed using STATA 14.0 (StataCorp, USA). Numerical data were presented with mean ± standard deviation and range, whereas categorical data were presented as count and percentage. To compare between preoperative and PO data, a Chi-square test was used for categorical; whereas to compare between mean values, paired sample *t*-test was used. A $P < 0.05$ was considered statistically significant.

RESULTS

During the study period, 5282 adult cataract patients were operated in our Paying section. Of them, a total of 850 (16%) had undergone unilateral cataract on the same day with 1 h preoperative antibiotic regimen. A total of 810 eyes of 805 patients who fulfilled the inclusion criteria were taken up for the study. Forty eyes (4.7%) were excluded from the study, due to inadequate follow-up. Although telephonic reminders were given, due to the second wave of COVID-19, most patients had postponed their review visits. Patients who were lost to follow-up and could not be contacted through telephone after 3 consecutive calls, were excluded from this study. The demographic characteristics are detailed in Table 1. Study group had five patients who had both eyes operated sequentially. Fifty-four percent (54%) patients were aged more than 60 years. The mean distance traveled by the patient to undergo surgery was 70.2 ± 69.4 km. The preoperative and intraoperative details are provided in Table 2. The mean preoperative BCVA was 0.8 ± 0.7 LogMAR. Polymethylmethacrylate IOL was implanted in 75 (9.3%) eyes and the rest had foldable IOLs implanted. Due to intraoperative challenge, there was inability to implant IOL in one eye. Eight hundred and two (802 = 99.0%) eyes had no intraoperative complications. Details of the 8 (1%) eyes who had intraoperative complications and the management are detailed in Table 3. The mean BCVA at PO 3 weeks among the patients with intraoperative complication was 0.16 ± 0.38 LogMAR. Fifty one (51 = 6.3%) had complications on POD 1, of which 33 had striate keratitis, 7 had iritis, and 11 had corneal edema. Nine (1.1%) had complications at PO 3 weeks which included 2 with striate keratitis, 5 with iritis, and 2 with corneal edema. Of the patients with PO iritis at 3-week PO, all the five had iritis at 1-day postoperative too. There were no cases of rebound iritis. Three out of five had mature cataract.

Table 1: Demographic characteristics (*n*=810)

	Count (%)
Age (*n*=805) (years)	
Mean±SD (range)	61.0±9.7 (27.0-85.0)
Gender (*n*=805)	
Male	415 (51.5)
Female	390 (48.4)
Laterality	
Right eye	478 (59.0)
Left eye	332 (41.0)
Comorbidities	
Ocular	16 (2.0)
Systemic	405 (50.0)
No comorbidities	389 (48.0)
Admission type	
Day care	745 (92.0)
Day admit	65 (8.0)

SD - Standard deviation

Three of them had systemic comorbidities. Three out of five achieved final vision better than 6/12 the other two had ocular comorbidities (Advanced PDR, Retinochoroidal coloboma) contributing to suboptimal vision. All the patients were asymptomatic during the follow-up and regular PO medications were provided. None developed endophthalmitis in this study period.

Table 2: Preoperative and intraoperative details

	Count (%)
Cataract grade	
Immature	664 (82.0)
Mature	143 (17.6)
Hypermature	3 (0.4)
IOP (mmHg)	
Mean±SD (minimum-maximum)	15.7±2.7 (9.0-25.0)
BCVA - preoperative	
Mean±SD (minimum-maximum)	0.8±0.7 (0.0-2.9)
Axial length (mm)	
Mean±SD (minimum-maximum)	23.0±1.0 (20.6-33.0)
Mean keratometry (D)	
Mean±SD (minimum-maximum)	44.8±1.6 (40.5-51.3)
Type of surgery	
Phaco	730 (90.1)
SICS	80 (9.9)
Anesthesia	
Sub-Tenon	320 (39.5)
Topical	490 (60.5)
IOL power (D)	
Mean±SD (minimum-maximum)	21.0±2.6 (−1-+32.5)
Lens type	
Polymethylmethacrylate IOL	75 (9.3)
Hydrophilic	
Single piece, acrylic, foldable	292 (36)
Hydrophobic	
Acrylic foldable IOL	397 (49.0)
Single piece, toric, acrylic foldable IOL	34 (4.2)
Single piece multifocal acrylic foldable IOL	11 (1.4)
No IOL	1 (0.1)

SD - Standard deviation, Phaco - Phacoemulsification, SICS - Small incision cataract surgery, IOL - Intraocular lens, IOP - Intraocular pressure, BCVA - Best-corrected visual acuity

The mean BCVA of the study group on POD 1 was 0.13 ± 0.3 Log MAR ranged from 0 to 2.6 Log MAR. Seven hundred and sixty seven (94.7%) achieved normal vision, 29 (3.6%) were categorized as visually impaired, 5 (0.6) as severe visual impairment, and 9 (1.1%) as blind. One hundred and twenty one (87.0%) out of 139 who had been preoperatively categorized as blind achieved normal visual acuity on POD1. Mean visual improvement from preoperative to POD1 was statistically significant ($P = 0.000$). The mean BCVA of the study group on PO 3 weeks was 0.07 ± 0.3 LogMAR ranged from 0 to 2.6 LogMAR. Comparison between preoperative BCVA and PO 3-week BCVA is provided in Table 4. Twelve (1.5%) eyes had PO 3-week CDVA <6/60 and their pre, intra, and PO details are provided in Table 5. Our study showed that in comparison to preoperative BCVA, at PO 3 weeks, 775 (95.68%) had improvement in vision and 32 (3.95%) had retained their preoperative vision. Three (0.37%) eyes had dropped vision by 1 line postoperatively and all these patients had preexisting systemic and ocular comorbidities. The mean preoperative BCVA was 0.83 ± 0.7 for all the 810 eyes. Compared to this, there was a significant improvement in POD1 mean BCVA (LogMAR) which was 0.13 ± 0.3 ($P = 0.0000$) and in PO, 3-week mean BCVA (LogMAR) was 0.07 ± 0.2 ($P = 0.0000$). A paired sample *t*-test was done to assess any significant changes between mean pre and PO BCVA. Compared to mean preoperative BCVA, there was a statistically significant improvement in the mean PO (both POD1 and PO 3 weeks) BCVA ($P < 0.001$).

DISCUSSION

With the rising COVID-19 cases, the ophthalmic community is facing extraordinary challenges to safely perform cataract

Table 3: Intraoperative complication and management (*n*=8)

Age/sex	Preoperative		Cataract type	Intra operative		Postoperative
	Visual acuity	Ocular co-morbidity		Complication	Management	BCVA (3 weeks)
70/female	2/60	PXF	HMC	ZD without VL	CTR	6/6
71/female*	2/60	Postcongestive stage of AACG, gross phacodonosis	HMC	Whole capsular bag removal with vitreous loss, inability to implant IOL	AV done	5/60
48/female	6/24	Nil	PPC	PCR (cortex wash)	AV done	6/6
61/female	5/60	PXF, phacodonosis	IMC	ZD, with VL	AV done	6/9
61/female**	2/60	Nil	MC	PCR with small epinuclear bit dropped into vitreous cavity	TPPV with epinuclear bit removal	6/6
65/male	PL+	PACS	MC	ZD without VL	CTR	6/6
48/male	6/18	Traumatic cataract, ZDs	IMC	ZD with VL	CTR, AV done	6/6
38/male	5/60	Nil	PPC	PCR (IOL dialing)	AV done	6/6

All the above 8 patients had Phaco surgery except two, of which one had *SICS and the other **Phaco converted to SICS. PXF - Pseudoexfoliation, AACG - Acute angle closure glaucoma, PACG - Primary angle closure glaucoma, ZD - Zonular dialysis: HMD - Hyper mature cataract, PPC - Posterior polar cataract, IMC - Immature cataract, MC - Mature cataract, VL - Vitreous loss, PCR - Posterior capsular rupture, IOL - Intraocular lens, CTR - Capsular tension ring, AV-Anterior vitrectomy, TPPV - Trans pars plana vitrectomy, BCVA - Best-corrected visual acuity

Table 4: Comparison between preoperative best-corrected visual acuity and postoperative 3-week best-corrected visual acuity

Preoperative CDVA	Postoperative week 3 CDVA				
	Normal	Visual impairment	Severe visual impairment	Blind	Total
Normal	419 (100.0)	-	-	-	419
Visual impairment	138 (95.8)	6 (4.1)	1 (0.7)	-	144
Severe visual impairment	104 (97.2)	1 (0.9)	1 (0.9)	1 (0.9)	107
Blind	123 (88.5)	7 (5.0)	3 (2.2)	6 (4.3)	139
Total	784 (96.8)	14 (1.7)	5 (0.6)	7 (0.9)	810

CDVA - Corrected distance visual acuity

Table 5: Pre, intra, and postoperative details of patients with postoperative 3-week best-corrected visual acuity worse than 6/60 (n=12)

Age (years)/ sex	Preoperative			Intra operative		Postoperative	
	Systemic comorbidities	Ocular comorbidities	BCVA/type of cataract	Complication	Management	PO 3-week BCVA	Additional procedure postcataract surgery
55/female	DM	Advanced PDR	6\60/IMC	Nil	Nil	5\60	VR surgery
71/female	HTN	Postcongestive stage of AACG	2\60/IMC	Whole capsular bag removal, vitreous loss, inability to implant IOL	AV	5\60	-
66/male	DM	PDR with VH with SHH	4\60/IMC	Nil	Nil	5\60	VR surgery
56/female	DM HTN	Ischemic CRVO Duane retraction syndrome	5\60/IMC	Nil	Nil	2\60	Intravitreal anti-VEGF injection
54/male	DM	Advanced PDR, tractional RD, lamellar macular hole	4\60/IMC	Nil	Nil	1\60	VR surgery
66/male	DM	VH with SHH, IPVD, 2° glaucoma	HM/IMC	Nil	Nil	HM	VR surgery
71/female	DM	Advanced PDR	1\60/IMC	Nil	Nil	HM	VR surgery
53/female	DM	Advanced PDR with tractional RD	1\60/IMC	Nil	Nil	1\60	VR surgery
48/male	DM	CRVO with VH	HM/IMC	Nil	Nil	HM	VR surgery
54/female	Nil	Microcornea, iris, retinochoroidal coloboma (Type 1)	HM/MC	Nil	Nil	5\60	-
56/female	HTN	Childhood strabismus, anisometropic amblyopia, high myopia, posterior staphyloma	HM/MC	Nil	Nil	3\60	-
73/male	Cardiac	PACG Glaucomatous optic atrophy, gross Phacodonesis	HM/HMC	Zonular dialysis	CTR placed and AV done	HM	Nil

BCVA - Best-corrected visual acuity, PO - Postoperative, DM - Diabetes mellitus, HTN - Hypertension, PDR - Proliferative diabetic retinopathy, AACG - Acute angle closure glaucoma, PACG - Primary angle closure glaucoma, VH - Vitreous hemorrhage, SHH - Subhyaloid hemorrhage, CRVO - Central Retinal vein occlusion, RD - Retinal detachment, HMC - Hyper mature cataract, PPC - Posterior polar cataract, IMC - Immature cataract, MC - Mature cataract, AV – Anterior vitrectomy, HM - Hand movement, VR - Vitreoretinal, Anti VEGF - Antivascular endothelial growth factor

surgeries. Very few ophthalmologists prefer to operate for cataract on the same day during their first consultation. There are only few reported studies in the literature on the outcome of cataract surgery with 1–2 h preoperative antibiotic regimen such as the study by Li *et al*.[8] and the clinical trial by Vasavada *et al*.[16,17] The study by Zhuang *et al*. suggested that it is essential to optimize day-case cataract surgery to decrease expense and increase efficiency, providing clear evidence that the practice pattern for cataract surgery has been evolving to address the need of the hour.[18]

Postoperative visual outcome

The longstanding WHO benchmark for a good outcome, following cataract surgery, is a presenting visual acuity of 6/18 or better. It is reported that with refraction, 85% had a BCVA of 6/18 or better.[1] Among the study group, 96.8% achieved BCVA 6/18 or better at PO 3 weeks. All the patients achieving PO vision of 6/60 or worse had ocular or systemic comorbidities. Zhuang *et al*. in their study reported the average preoperative BCVA of 1 ± 1.3 LogMAR and average PO BCVA at 1 month were 0.1 ± 0.6 Log MAR, similar to our study report.[18]

Intraoperative complications

Retrospective cohort study by Haripriya *et al*. reported the intraoperative complication rate as 0.8% and a total of 0.04% of PO endophthalmitis. The BCVA was better than 6/12 in 96% after phacoemulsification complications and 89% after manual SICS complications.[19] In our current study, intraoperative complications rate was 1%. A study from a private practice in Madrid, Spain, stated that 28.5% had prior ocular pathologies and majority of them with retinal pathologies

that had compromised visual outcomes.[20] The main reason for PO 3-week BCVA worse than 6/60 in the present study among 10 out of 12 patients were due to preexisting retinal pathology [Table 5]. Han *et al*. in a prospective cohort study reported an overall intraoperative complication rate of 3.0%, with no cases of PO endophthalmitis. It recommended cataract risk stratification approach to reduce the trend in frequency and severity of intraoperative complications.[21]

Postoperative surgical outcome and Endophthalmitis prophylaxis

The optimum length of time, frequency, duration, drug of choice, and manner of antibiotic cover for perioperative topical antibiotic prophylaxis have been debated.[22] Kelkar *et al*. in an online ophthalmologist survey reported that 37% started preoperative antibiotics 3 days before surgery, 37% started them on the day before surgery, and only 10% started them on arrival at the surgical center. Nearly 94% of respondents used topical povidone-iodine immediately before surgery. Eighty-five percent injected intracameral antibiotics. Kelkar concluded that intracameral antibiotic prophylaxis had sharply increased in India and had resulted in a reduction of self-reported endophthalmitis cases.[7] The major risk expected with only 1 h preoperative antibiotic regimen is PO endophthalmitis. Li *et al*. in their prospective randomized study evaluated the efficacy of combination preoperative prophylactic topical antibiotic regimen given 1 h versus 1 day before surgery in addition to perioperative povidone-iodine disinfection. Their study proved the equal effectiveness in reducing the conjunctival bacterial load in both groups and the greatest safety effect was achieved by irrigating the conjunctival sac with povidone-iodine.[8] Nentwich *et al*. and Tan *et al*., respectively, attributed the reason for the reduction in the rate of PO endophthalmitis to implementation of a preoperative prophylaxis protocol using copious povidone-iodine.[23,24] Vasavada *et al*. compared two moxifloxacin regimens for preoperative cataract prophylaxis. Group A had moxifloxacin instilled 4 times a day, 1 day before surgery along with 1 drop 2 h before surgery, while Group B had moxifloxacin instilled 2 h before surgery and then every 15 min for 1 h. They found that both the regimens achieved significant higher aqueous concentrations and reduced the amount of conjunctival bacterial flora.[16,17]

Intracameral antibiotics for endophthalmitis prophylaxis

The mode of antibiotic administration ranged widely from topical administration preoperatively to intraocular injections during surgery. Tan *et al*. also reported that there was a significant reduction in the rate of endophthalmitis with the use of intracameral cefazolin.[25] Several multicentric trials and studies have also recommended intracameral antibiotic (s) at the end of surgery to reduce the occurrence of PO endophthalmitis.[26-29] Haripriya *et al*. proved that a routine intracameral moxifloxacin prophylaxis reduced the overall endophthalmitis rate by 3.5 fold and also reduced the PO endophthalmitis rate in eyes with PCR.[30-32] In a review of the incidence of acute postcataract surgery endophthalmitis in India, it was reported between 0.04% and 0.15%.[33] In our study, patients received preoperative antibiotic E/D ofloxacin 0.3% (Auroflox, Aurolab, India), 1 h before cataract surgery, applied for 6 times every 10 min, followed by perioperative povidone-iodine usage in the conjunctival sac and intracameral moxifloxacin. During the study period, there was no reported case of endophthalmitis. None of previous studies have reported on the visual and surgical outcomes, especially on the endophthalmitis rates with 1–2 h of preoperative antibiotics regimen.[8,16,17] However, in our descriptive study, both the PO BCVA and the surgical complications (including endophthalmitis rates) were analyzed.

Since India is in the postsecond COVID-19 wave, there will be an increase in the outpatient visits and consultation for elective procedures upon return to near normalcy. It has been reported that the pandemic will probably lead to deterioration in the social determinants of eye health for many, through increased poverty and reduced access to services mainly in developing countries.[1] Strategies suggested to cope with the backlog of cataract surgery include the adoption of telemedicine, artificial intelligence-assisted platforms, modification of face-to-face encounters, better theater organization, moving the FEMTO laser to the operating room or alternatives to laser-assisted capsulotomy such as zepto and miLoop for dense cataract and immediate sequential bilateral cataract surgery (ISBCS).[13,14,34] Although globally, there is an ongoing debate on ISBCS. This approach has been adopted as a practice pattern among ophthalmologists from the developed world and has been suggested as a strategy to tackle surgery backlogs.[34-37] Due to the concern of the dreadful bilateral endophthalmitis with ISBCS and surgical surprises, such practice is less prevalent in India.[38]

Despite the existence of the knowledge regarding the safety of cataract surgery with same-day preoperative antibiotic, there exists an hesitance in adopting this into their current practice by many clinicians.[7,39] Therefore, along with the suggested strategies, adopting the Delayed Sequential Bilateral Cataract Surgery with 1 h of antibiotic regimen would be appropriate to tackle the cataract surgery backlog in India. This study has proven this to be a safe strategy. Many more institutions and practitioners are encouraged to adopt the strategy. Nevertheless, a sterile operative field has to be achieved by adopting routine prophylaxis protocols,

disinfecting the skin in the periorbital region, and irrigating the conjunctiva using topical povidone–iodine.[5,8]

Although a case–control study would have been ideal, this was not feasible during the period of the ongoing pandemic. However, the study used historical rates to test the hypothesis. Another limitation was a follow-up of 3-week duration. The long-term PO effects are being currently followed up. In 3-week duration, it clearly indicated an excellent surgical and visual outcome, minimized the number of visits, reduced the hospital stay days, reduced the number of attendees exposing themselves to the hospital environment, and minimized exposure for the hospital staff. However, our recommended protocol for same-day antibiotics depends on a dedicated team work, adequate manpower, and stringent sterilization protocols, as well periodic monitoring, to achieve safe surgical and medium-term PO visual outcomes.

CONCLUSION

COVID-19 pandemic has resulted in the worsening of the backlog of cataract surgeries. Modified approaches are required to tackle the situation. Our strategy has successfully proven that same-day evaluation, with 1 h of preoperative antibiotic regimen along with intraoperative povidone-iodine and intracameral moxifloxacin, provides safety against PO endophthalmitis with good visual and surgical outcomes. This strategy significantly reduces the number of hospital visits and increases patient compliance and comfort. We suggest clinicians in developing countries to adopt the above approach which will benefit the patients, as well as effectively tackle the backlog of cataract surgeries during exigent times.

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Etiology of permanent visual impairment among persons attending a disability board in Central Kerala

ABSTRACT

Introduction: Permanent visual handicap is one of the most troublesome disabilities to affect an individual, a family, and a society. **Objectives:** To determine the important etiological factors leading to permanent visual impairment (VI) in Kerala and their frequency trends over the recent years. **Materials and Methods:** Retrospective study of case records of the medical board of a government medical college hospital in Kerala from 2017 to 2020. **Inclusion Criteria:** Data of all individuals with permanent VI of categories 1 to 4. **Exclusion Criteria:** Category zero of permanent disability. The guidelines included under the Rights of Persons with Disabilities Act, 2016 were followed for assessing the extent of visual disability. The age, gender, place, diagnosis in the right eye, diagnosis in the left eye, and percentage of disability were entered in an Excel spreadsheet and analyzed by SPSS software (version 20.0). **Results:** Data of 545 persons were analyzed. The mean age ± SD was 36.21 ± 17.70 years. Most of the study population were males (n = 348, 63.85%). The most frequent etiological factors noted are congenital malformations of the eye (20.18%), high myopia (14.13%), corneal blindness (13.58%), trauma (11.56%), optic atrophy (10.46%), retinitis pigmentosa (7.34%), and advanced diabetic eye disease (3.85%). 50% of factors were preventable and nearly 50% were causing progressive worsening of disability. **Conclusion:** There is a slowly increasing proportion of congenital malformations, congenital cataracts, and glaucoma. Corneal blindness showed a decreasing trend.

Keywords: Certification, preventable blindness, visual disability India

INTRODUCTION

Permanent visual handicap is one of the most troublesome disabilities to affect an individual, a family, and a society.[1] As per Census 2011, in India, out of the 121 crore population, about 2.68 crore persons (2.21%) are "disabled." Approximately 19% of the 2.68 crore persons with disability have a visual disability.[2] Approximately 30% of children with disability have a visual handicap.[2] Visual impairment (VI) includes both low vision and blindness.[3] Some causes of VI are amenable to prevention and treatment.

Visual rehabilitation is the only solution for persons suffering from non-preventable causes of VI or having permanent blindness. The Government of India (GOI) offers many benefits such as jobs, travel concession, income tax benefits, etc., based on the severity of the disability.[4] World Health Organization (WHO) has given certain standards for classifying the severity of the visual disability for each person in the International Classification of Diseases-10.[5] The definition of blindness under the National Program for Control of Blindness (NPCB), GOI differs from the definition adopted by the WHO.[6,7] Rights of Persons with Disabilities Act, 2016 have further modified these criteria to match that of WHO.[8]

Kerala is the most literate state in India with an excellent three-tier system of healthcare facilities available to all

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sections of society.[9,10] There is a well-planned, smoothly functioning, and regular system of the medical board from the secondary care level onwards to provide certificates for persons with disability. Disability board registers are important data sources for research to detect the magnitude of the problem in society.[1] Data are needed on service provision, service outcomes, and the economic benefits of rehabilitation.[11] Evidence for the effectiveness of interventions and programs is extremely beneficial to guide policymakers in developing appropriate services, to allow rehabilitation workers to employ appropriate interventions, and also to support people with disabilities in decision-making.[1] Identifying the major causes of disability is very important for preventive measures. We designed a study of the medical records of one of the disability boards functioning in a district of central Kerala, to determine the etiology, possible preventable causes, and trends of etiological factors for permanent visual disability with an aim to streamline possible preventive and curative services.

MATERIALS AND METHODS

This was a retrospective observational study of the data of the medical board of a government medical college hospital in central Kerala from 2017 to 2020 after getting permission from the relevant authority and institutional ethical committee in accordance with the Declaration of Helsinki. The visual disability was certified by a medical board comprising of one ophthalmologist and three other specialists. A thorough examination of visual acuity, anterior segment, and posterior segment of eyes along with required investigations like tonometry, perimetry, gonioscopy, optical coherence tomogram (OCT) are done routinely before certification for all the persons attending the medical board. The medical board follows the guidelines included under the Rights of Persons with Disabilities Act, 2016 (49 of 2016) given in the Gazette of India: Extraordinary [part ii—sec. 3(ii)] for assessing the extent of specified disability in a person.[8] According to this act, in India,

(a) "**Blindness**" means a condition where a person has any of the following conditions, after best correction—(i) total absence of sight; or (ii) visual acuity less than 3/60 or less than 10/200 (Snellen) in the better eye with best possible correction; or (iii) limitation of the field of vision subtending an angle of less than 10°.

(b) "**Low-vision**" means a condition where a person has any of the following conditions, namely—(i) visual acuity not exceeding 6/18 or less than 20/60 up to 3/60 or up to 10/200 (Snellen) in the better eye with best possible corrections; or (ii) limitation of the field of vision subtending an angle of less than 40° up to 10°.

VI certification criteria and gradation vision assessment were done after best possible correction (medical, surgical, or usual/conventional spectacles).

The percentage of VI was calculated according to guidelines issued by the Ministry of Social Justice and Empowerment, GOI[8] [Table 1]. The certificate of disability must be countersigned by the medical superintendent or chief medical officer or civil surgeon or any other equivalent authority as notified by the state. The medical board keeps a well-maintained register regarding the number of patients attending each week with their address, type and percentage of disability, etiological diagnosis, and details of the condition causing disability.

We retrieved the data of all individuals with permanent VI of categories 1 to 4 from the records. Temporary VI and category 0 of permanent disability (less than 20% disability) were excluded. The age, gender, place, diagnosis in the right eye, diagnosis in the left eye, and percentage of permanent visual disability were collected and entered in an Excel spreadsheet and analyzed by SPSS software (version 20.0) manufactured by IBM Corporation, United States of America.

The etiological factors given in the diagnosis were further analyzed and categorized as preventable or non-preventable and progressive, stationary, or regressive. Preventable causes of visual disability were defined as conditions, which can be prevented or treated effectively to prevent permanent visual disability. Non-preventable causes were those conditions leading to permanent disability, which cannot be prevented or treated effectively even with early diagnosis and advanced facilities available now.

Some pathologies are progressive, some static, and some regressive in behavior. Progressive causes are conditions that worsen over time even with treatment. Stationary causes do not change in severity once occurred and regressive causes are those conditions, which improve over time with or without treatment. Statistical analysis was done by SPSS software (version 20.0).

RESULTS

We analyzed data of 545 persons who attended medical board from January 1, 2017 to January 1, 2021. There were 169 entries in 2017, 193 in 2018, and 156 in 2019; however, only 27 persons attended the medical board in 2020 due to the COVID-19 pandemic effect and lockdown. The mean age ± SD of the study population was 36.21 ± 17.70 years (range 1 to 76 years, interquartile range 21 to 50 years). The mean age of people with permanent

Table 1: Guidelines for categorization of visual impairment

Better eye (best corrected)	Worse eye (best corrected)	Percent impairment	Disability category
6/6 to 6/18	6/6 to 6/18	0%	0
	6/24 to 6/60	10%	0
	Less than 6/60 to 3/60	20%	I
	Less than 3/60 to No light perception	30%	II (one eyed person)
6/24 to 6/60 Or Visual Field less than 40 upto 20 degree around centre of fixation or hemianopia involving macula	6/24 to 6/60	40%	III a (low vision)
	Less than 6/60 to 3/60	50%	III b (low vision)
	Less than 3/60 to No light perception	60%	III c (low vision)
Less than 6/60 to 3/60 or Visual Field less than 20 upto 10 degree around centre of fixation	Less than 6/60 to 3/60	70%	III d (low vision)
	Less than 3/60 to No light perception	80%	III e (low vision)
Less than 3/60 to 1/60 or Visual Field less than 10 degree around centre of fixation	Less than 3/60 to No light perception	90%	IV a (blindness)
Only HMCF Only Light perception No light perception	Only HMCF Only Light perception No light perception	100%	IV b (blindness)

visual disability coming for certification to the study center showed a significant (one-way analysis of variance (ANOVA) test $P = 0.04$) decline with each year. The mean age was 39.12 ± 18.27 years in 2017, 35.80 ± 17.27 years in 2018, 34.42 ± 17.44 years in 2019, and 31.22 ± 16.77 years in 2020. Table 2 presents the mean age by different categories of visual disability in the study population.

Overall, the study population was predominantly male ($n = 348$, 63.85%) and did not show a statistically significant gender difference by year (X^2 test $P = 0.67$).

Diagnosis (that lead to the disability) of the right eye and left eye were given in the medical records with the best-corrected visual acuity in each eye. The year-wise distribution and frequency of uniocular diagnosis are shown in Table 3.

The most frequent factors noted are congenital malformations of the eyeball or visual pathway, uncorrected refractive errors mainly high myopia leading to amblyopia or other complications, corneal blindness, trauma, optic atrophy, retinitis pigmentosa, and advanced diabetic eye disease. The diagnosis mainly attributed to the categorization of disability is shown in Table 4. One hundred and fifty-eight cases (28.99%, 95% CI: 25.34, 32.94) were categorized as one-eyed (category 2).

The trend analysis showed a slowly increasing frequency of congenital malformations, congenital cataracts, and glaucoma over the years from 2017 to 2019. Corneal blindness showed a decreasing trend [Table 4].

We also analyzed whether the causative factors were preventable or non-preventable and found that half of the pathologies were either preventable or effectively treatable. Regarding the natural course of diseases, about half the causative diseases were progressive in nature. See Table 5.

DISCUSSION

As per the "Survey of Persons with Disabilities in India" conducted during the National Sample Survey Organization (NSSO) 76th round (July–December 2018), the prevalence of disability is 2.2 percent in India, and 0.3% of the rural population and 0.2% of the urban population suffer from a visual disability.[12]

The NSSO-2002 reported that VI is a problem of old age in India. About 68 to 72% acquired VI at the age of 60 years and above and the causes were shown as "old age" and cataract.[13] The Aravind comprehensive eye survey of blindness and vision impairment in a rural south Indian population, done in the same period also showed age-related cataract was the most common potentially reversible blinding disorder (72.0%) among eyes presenting with blindness.[14] However, better facilities and access to eye care are leading to a shift in this paradigm. Better survival of preterm infants and children with congenital anomalies has increased the proportion of younger age groups with visual disabilities. We found a greater number of younger aged people attending the study center for certification with each year [Table 2]. It is also possible that the increasing proportion of younger aged people coming for certification is related to the various benefits and job opportunities given to disabled persons. This may provide an incentive to the young to get the certificate if they have any disability. Several recent studies have shown that most of the applicants belong to the age group of 16 years to 45 years.[15-18]

We found a higher proportion of males with disability in the study population although the difference was not statistically significant [Graph 1]. The higher proportion of males with a disability is comparable to other studies from India.[15-19] The lack of significance possibly indicates that more females are coming forward to receive certification for various benefits.

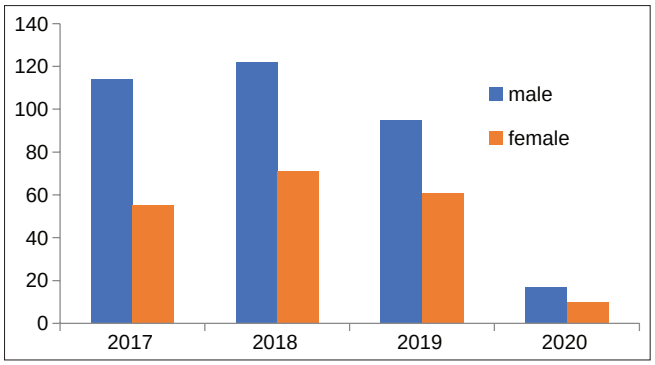
Category **C** (40–80%) disability was more common in this series [Table 2] similar to other South Indian studies,[18,19] but different from the studies by Khan *et al*.[15] and Ghosh *et al*.[16] They found that a maximum number of applicants belonged to the blindness (100%) category. This may be because of the difference in population included in the study or maybe related to the awareness of possible benefits from certification among those with visual disabilities. In our population, only 89 cases (16.33%) had category 4 (90–100%) disability [Table 2] suggesting that more people with lesser grades of visual disability were willing to obtain certificates.

Many of the patients [158 cases (29%)] who appeared before the medical board were category 2 (one-eyed) patients with 30% visual disability [Tables 4 and 5]. This observation is consistent with that of Khan *et al*.[15]

Congenital malformations of the eye, high myopia, corneal causes, trauma, optic atrophy, retinitis pigmentosa, diabetic eye disease, retinal detachment, and glaucoma were the main causes of permanent visual disability in our series [Table 4]. This result is similar to that of other South Indian studies by Khan *et al*.[15] and Dadapeer Kareemsab *et al*.[19] but Ambastha A, *et al*.[17] found that the most common cause of visual handicap (40–100% impairment) and blindness (75–100% impairment) was macular pathology ($p < .05$), while the most common cause of overall VI (20–100% impairment) was amblyopia.[17] Congenital abnormalities were fourth in their frequency

Table 2: Severity of disability and mean age in the study population

% Disability	Mean age	Standard deviation	Frequency	% of total cases
20%	20.909091	13.442132	11	2.01%
30%	38.638889	16.669232	180	33.027%
40%	32.661538	17.124059	130	23.85%
50%	34	16.337353	34	6.24%
60%	29.775	16.449593	40	7.33%
70%	21.666667	14.640128	3	0.55%
80%	34.706897	17.47179	58	10.64%
90%	28.5	18.596595	10	1.83%
100%	45.481013	18.070276	79	14.49%
Total	36.209174	17.697943	545	100%



Graph 1: Gender Distribution

Table 3: Diagnosis in each eye and the year-wise frequency distribution*

Uniocular diagnosis	Year-wise frequency in right eye				Year-wise frequency in left eye			
	2017	2018	2019	2020	2017	2018	2019	2020
Congenital malformations of the eye	28	33	34	5	25	30	36	3
Congenital cataract	3	7	9	0	3	5	8	0
High myopia and complications	21	33	19	3	22	31	17	3
Other refractive errors with amblyopia	1	1	3	0	5	8	4	2
Strabismus and amblyopia	5	6	1	0	4	6	0	0
Corneal pathologies	32	23	9	2	18	13	7	1
Glaucoma	2	3	9	1	2	3	9	1
Optic atrophy	13	23	12	2	10	24	11	2
Retinitis pigmentosa	16	9	12	3	16	9	12	3
Rupture globe and phthisis bulbi	12	10	8	2	5	3	5	3
Traumatic optic neuropathy	3	1	10	0	3	1	1	1
Diabetic eye disease	5	8	5	3	5	8	5	3
Retinal detachment	6	6	3	1	6	4	5	0
Eye within normal limits	15	17	16	4	36	38	32	4

*Other conditions with fewer frequency that are not shown in the table include retinopathy of prematurity ($n=2$ eyes), uveitis ($n=12$ eyes), retinal dystrophy ($n=21$ eyes), age related macular degeneration [ARMD] ($n=6$ eyes), central retinal vein occlusion [CRVO] ($n=2$ eyes), central retinal artery occlusion [CRAO] ($n=1$ eye), retinoblastoma ($n=5$ eyes), orbital lymphoma ($n=2$ eyes), and post-operative endophthalmitis ($n=1$ eye)

order [Table 4]. The difference may be because of the different populations involved in the studies.

The most frequent etiological factor in our study was congenital malformations of the eyeball and visual pathway including microphthalmos, microcornea, coloboma, anterior segment dysgenesis syndromes, and congenital nystagmus [Table 4]. There were two cases of anophthalmia also. These are non-preventable in the present scenario. The possibility of prevention lies at the level of genetic counseling, prevention of consanguineous marriage (which is still a common practice in South India), and effective prenatal diagnosis of congenital abnormalities. Another important perinatal cause was congenital cataract [Table 4] and all these cases had received cataract surgery. But none of them had perfect vision, may be because of delayed surgery or inadequate post-operative follow-up and improper management of amblyopia. Another aspect noted was only one-third of cases were pseudophakic. Strengthening the pediatric ophthalmology subspecialty for early surgery, efficient post-operative follow-up, secondary intraocular lens (IOL) implantation in time, and prevention of amblyopia are very essential and may help to reduce the magnitude of permanent visual disability due to congenital cataracts. Congenital cataracts, strabismus, and amblyopia are preventable/treatable causes of disability if there are facilities.

The second commonest etiological factor in this series was uncorrected refractive errors with most having high myopia [Table 4]. Amblyopia and the complications of pathological myopia equally contributed to the development of disability. Though we cannot prevent the occurrence of all refractive errors, early detection, correction, and treatment of complications with proper follow-up can lead to a tremendous reduction of visual disability. Government and the public health system can implement regular school health programs with ophthalmological examination from kindergarten level onwards for the same.

Corneal blindness had the highest frequency in 2017 and was reduced to the third common etiology in the study population [Table 4]. Corneal opacity, dystrophy, failed graft, chemical burns, Steven–Johnson syndrome, and phthisis due to perforation of corneal ulcer were included in this group. This is also a preventable/treatable factor. Many cases were failed grafts exposing the need for better facility and surgical training in the field of keratoplasty. The decreasing trend of this causative factor over the years is significant and encouraging. We did not have trachoma or vitamin A deficiency as causative factors.

We found trauma as another important etiological factor causing disability for the productive age group [Table 4]. There was an increase in the number of cases in recent years, similar to the findings of other studies.[15,16] This may be due to the fact that the ocular injuries in road traffic accidents and injuries in factory workers are increasing. Two-thirds of our cases were open globe injuries and the remaining traumatic

Table 4: Etiological causes of permanent visual disability by year

Diagnosis	2017	2018	2019	2020	Total	Frequency %
Congenital malformations	29 (17.16%)	35 (18.13%)	40 (25.64%)	6 (22.22%)	110	20.18
Myopia and complications	23 (13.61%)	34 (17.62%)	17 (10.90%)	3 (11.11%)	77	14.13
Corneal pathologies	34 (20.12%)	27 (13.99%)	11 (7.05%)	2 (7.40%)	74	13.58
Trauma	20 (11.83%)	15 (7.77%)	23 (14.74%)	5 (18.52%)	63	11.56
Optic atrophy	15 (8.88%)	26 (13.47%)	14 (8.97%)	2 (7.40%)	57	10.46
Retinitis pigmentosa	16 (9.47%)	9 (4.66%)	12 (7.69%)	3 (11.11%)	40	7.34
Diabetic eye disease	5 (2.96%)	8 (4.15%)	5 (3.20%)	3 (11.11%)	21	3.85
Retinal detachment	6 (3.55%)	7 (3.63%)	7 (4.49%)	1 (3.70%)	21	3.85
Congenital cataract	3 (1.78%)	7 (3.63%)	8 (5.13%)	0 (0%)	18	3.30
Glaucoma	2 (1.18%)	3 (1.55%)	9 (5.77%)	1 (3.70%)	15	2.75
Strabismus and amblyopia	5 (2.96%)	7 (3.63%)	1 (0.64%)	0 (0%)	13	2.39
Retinal dystrophies	3 (1,78%)	6 (3.11%)	2 (1.28%)	0 (0%)	11	2.02
Other refractive errors	4 (2.37%)	1 (0.52%)	3 (1.92%)	0 (0%)	8	1.47
Uveitis	2 (1.18%)	2 (1.04%)	1 (0.64%)	1 (3.70%)	6	1.10
Retinoblastoma	1 (0.59%)	2 (1.04%)	1 (0.64%)	0 (0%)	4	0.73
Vascular occlusions	0 (0%)	3 (1.55%)	0 (0%)	0 (0%)	3	0.55
ARMD	1 (0.59%)	0 (0%)	0 (0%)	0 (0%)	1	0.18
Retinopathy of prematurity	0 (0%)	0 (0%)	1 (0.64%)	0 (0%)	1	0.18
Endophthalmitis	0 (0%)	0 (0%)	1 (0.64%)	0 (0%)	1	0.18
Malignancy (lymphoma)	0 (0%)	1 (0.52%)	0 (0%)	0 (0%)	1	0.18
Total cases	169	193	156	27	545	100

Table 5: Frequency distribution of categories of permanent visual disability, preventable/non-preventable causes of blindness, and progressive/static/regressive blindness detected by this study

Year	Number of patients awarded permanent visual disability	Number of patients with visual disability category 1 and 2 (20-30%)	Number of patients with visual disability category 3 (40-80%)	Number of patients with visual disability category 4 (90-100%)	Number of patients with preventable blindness	Number of patients with non-preventable blindness	Number of patients with progressive causes	Number of patients with stationary causes	Number of patients with regressive causes
2017	169	60 (35.50%)	81 (47.93%)	28 (16.57%)	85 (50.30%)	84 (49.70%)	83 (49.11%)	85 (50.29%)	1 (0.59%)
2018	193	70 (36.27%)	94 (48.70%)	29 (15.03%)	104 (53.89%)	89 (46.11%)	99 (51.30%)	94 (48.70%)	0 (0%)
2019	156	51 (32.69%)	79 (50.64%)	26 (16.67%)	70 (44.87%)	86 (55.13%)	67 (42.95%)	88 (56,41%)	1 (0.64%)
2020	27	10 (37.04%)	11 (40.74%)	6 (22,22%)	11 (40.74%)	16 (59.26%)	13 (48.15%)	14 (51.85%)	0 (0%)
Sum	545	191 (35.05%)	265 (48.62%)	89 (16.33%)	270 (49.54%)	275 (50.46%)	262 (48.07%)	281 (51.56%)	2 (0.37%)

optic neuropathy. Most of them resulted in uniocular total loss of vision contributing to category 2 (30%) disability. We included this in the non-preventable group as most of them reach the specialist after the golden hours of treatment and most are irreversible once it has occurred. The plight of one-eyed persons needs attention. They face all the challenges and disadvantages of uniocularity like driving difficulties, decreased field of vision, loss of job, mental agony, and inferiority complex of being one-eyed. At the same time, they do not have access to benefits as a disabled person. According to the guidelines for disability by the Ministry of Social Justice and Empowerment of the GOI, the minimum degree of disability should be 40% for an individual to be eligible for any concessions or benefits.[20] Enforcement of traffic rules, applying strict safety precautions in the worksite, appropriate timely treatment, etc., can decrease the incidence of this mishap.

Advanced diabetic eye disease is another emerging major risk factor for progressive visual disability in our population [Table 4]. Kerala is the diabetic capital of India and has double the national average of 8%.[21,22] Serious effort must be taken from the grass root level for controlling this lifestyle disease and its complications. Timely screening of all diabetic patients for retinopathy must be instituted. Public awareness regarding diabetic retinopathy also can play a big role in early detection and management. We had a significant number of retinal detachments in the diagnosis similar to other Indian studies.[15,16] The increase in retinal detachment may be secondary to pathological myopia, post-cataract surgery, and diabetic retinopathy. So, strengthening the vitreoretinal subspecialty at all levels of healthcare is the need of the hour.

The number of glaucoma cases in our study was less (2.93%) compared to other studies.[15,16] The public awareness, regular glaucoma screening camps, and clinics may be the reason for the reduction of glaucoma as a causative factor for permanent visual disability. Another possibility is patients may not be aware of the field defect they are having and the significance of the field of vision in the calculation of the percentage of disability. The increasing trend observed over the years supports this explanation.

The strength of this study is the recognition of the basic pathology of each causative factor. For example, phthisis is a very commonly written diagnosis in disability certificates. We analyzed its causation - whether it occurred following a traumatic rupture globe or endophthalmitis or a perforated/eviscerated corneal ulcer. Vitreous hemorrhage, retinal detachment, and neovascular glaucoma following diabetic retinopathy were classified under advanced diabetic eye disease. This enabled us to identify the underlying disease, whether it could be preventable or treatable at any point of time. Depending on the natural course of diseases, we classified them as progressive, regressive, or static. Overall we found that around 50% of etiological factors were preventable. Nearly 50% of diseases were causing progressive worsening of disability [Table 5]. As the condition changes, the type of support including health benefits, special equipment for support, work accommodation, etc., also needs to change. The trend analysis [Table 4] showed a slowly increasing proportion of congenital malformations, congenital cataracts, and glaucoma suggesting the need for special attention to tackle these in the coming years. Corneal blindness showed a decreasing tendency over the years suggesting the success of already implemented measures and encouraging further progress in the same direction. The etiological distribution highlights the need to strengthen ophthalmology training in subspecialties and to introduce more programs with a subspecialty focus.

Limitation of the study

We studied the data of only one medical board of the district and the data may not be representative of the entire district. A larger study of all the boards of the district, state, and country is possible at a low cost and will give a clearer picture.

CONCLUSION

Congenital malformations of the eyeball, high myopia, corneal causes, trauma, optic atrophy, retinitis pigmentosa, diabetic eye disease, and retinal detachments are the main causes of permanent visual disability in our series of permanent visual disabilities and 50% of them are preventable. The trend analysis showed a slowly increasing frequency of congenital malformations, congenital cataracts, and glaucoma. The etiological distribution highlights the need to strengthen ophthalmology training in subspecialties and to introduce more programs with a subspecialty focus.

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Conflicts of interest

There are no conflicts of interest.

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Original Article

The consequences of dermis fat graft in the reconstruction of anophthalmic socket with large orbital implant exposure

ABSTRACT

Purpose: To present our results of dermis-fat graft as a secondary procedure after implant extrusion. **Materials and Methods:** A retrospective chart review was performed to examine 34 anophthalmic socket carriers undergoing dermis-fat graft. All patients had a history of ocular trauma and underwent evisceration surgery. Small defects and Grade 5 contracted sockets were not included. The patients reported the complaints of pain and discharge. Data were collected on the characteristics of the exposed implant material and surgical technique used for implant insertion; complications related with dermis-fat graft, cosmesis; and functional results such as the ability to hold an external prosthesis. For socket reconstruction, the graft was taken from the lateral upper quadrant of the gluteal region, 30% larger than the orbital defect. The mean follow-up period was 12.26 ± 1.13 months. **Results:** Of the 34 patients, 26 had porous polyethylene implants and 8 had acrylic implants. The average diameter of the conjunctival defect with scleral melting was 11.6 mm. The findings encountered in the follow-up of patients who underwent socket reconstruction with dermis-fat graft were as follows: graft necrosis in one patient, reduction in graft size in two patients, insufficient vascularization of the graft in one patient, ptosis in two patients, deep superior sulcus in one patient, cysts over the dermis-fat graft in one patient, and necrosis at the donor site in two patients. Except for two patients with fornices shrinkage, all of them used their ocular prosthesis well. **Conclusion:** Dermis-fat graft with low complication rate is a good option for anophthalmic socket reconstruction, but care of the donor site should not be neglected.

Keywords: Anophthalmos, conjunctival defect, dermis-fat graft, implant exposure

INTRODUCTION

Orbital implants are used to provide orbital integrity by compensating the reduced orbital volume in enucleation or evisceration surgery.[1-5]

However, it is a major problem that the implant causes a chronic inflammatory reaction, leading to necrosis in the conjunctiva and Tenon's capsule with an exposure rate, ranging from 2% to 10%.[1,3,6,7] If the exposure area is small and the signs of inflammation are mild, observation, topical drops, or repair with a mucosal graft is recommended, but if the conjunctival defect is large with severe infection, autologous dermis-fat graft, which was first described in 1978, is advised to compensate the volume loss both cosmetically and functionally.[1,8-10]

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Dermis-fat graft has the advantages that it does not carry the risk of disease transmission and graft rejection and does not require special preparation or storage in the tissue bank.[1,11]

The most preferred area for grafting is the lateral upper quadrant of the gluteal region. It is more easily accessible than other donor areas and causes mild postoperative pain and discomfort. In addition, grafts can also be taken from the abdomen or periumbilical region.[1,12,13]

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In order to increase the success of dermis-fat graft, the rectus muscles should be meticulously sutured to the dermal margin of the graft, filleting Tenon's capsule and avoiding cauterization of the graft bed.[1,14]

Here, we want to discuss our results of the dermis-fat graft, which we used to ensure socket integrity in our patients with implant exposure with excessive melting of the sclera.

MATERIALS AND METHODS

The medical records of 34 anophthalmic socket carriers who underwent secondary dermis-fat graft procedures, between March 2006 and December 2019, were reviewed retrospectively. The study protocol adhered to the tenets of Declaration of Helsinki and was approved by the ethics committee (decision number: 2020/514/181/6). Patient consent to publish identifiable photograph archival was taken from all patients.

A total of 34 patients, 14 males and 20 females, who had previously undergone evisceration surgery due to trauma and complaining about pain and irritation due to implant exposure, were included in the study. All patients had a large conjunctival defect, scleral melting with a diameter of 11.6 ± 1.4 mm (range, 10–14 mm), and discharge [Figure 1]. Small defects and Grade 5 contracted sockets were excluded.

Data were collected on structure of the exposed implant; the technique used in evisceration surgery; complications related with dermis-fat graft used for socket reconstruction; and cosmetic and functional results, such as the ability to hold an external prosthesis. Patient demographics and ocular characteristics are presented in Table 1.



Figure 1: Exposure of orbital implant with large conjunctival defect and scleral melting

As the remaining sclera and volume were insufficient for the secondary implant insertion, we used dermis-fat graft for socket reconstruction.

Patients were operated under general anesthesia, and all procedures were done by the same surgeon. The lateral upper quadrant of the gluteal region was preferred for donor site. Intradermal injection of saline solution was applied to the marked donor area to facilitate de- epithelialization of the skin from the graft, and the graft consisting only of the dermis and fat was excised. Graft was taken 30% larger than the orbital defect (oversized of 30 mm in height and 35 mm in length with 20 mm of the fat thickness) [Figure 2].

Table 1: Demographic and ocular characteristics of patients who underwent dermis-fat graft procedure

Patients	*n* (%)
Age (years)	
Median	40.3±15.0
Minimum	20
Maximum	65
Gender	
Male	14 (41.2)
Female	20 (58.8)
Indication for eye removal	
Trauma-related absolute eye	34 (100)
Indication for dermis-fat graft	
Primary	-
Secondary	34 (100)
Diameter of the conjunctival defect (mm)	11.6±1.4 (10-14)
Number of surgery prior to dermis-fat graft	1
Secondary surgical intervention for fornix reconstruction	2 (5.9)
Exposed implant	
Porous polyethylene	26 (76.5)
Acrylic	8 (23.5)

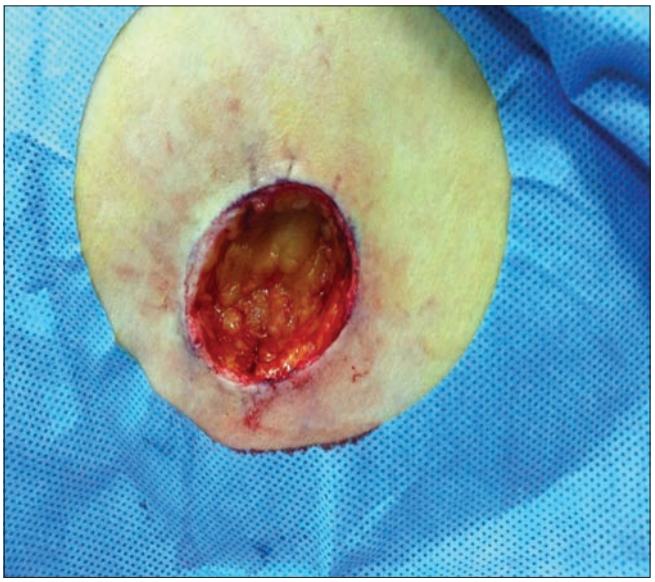


Figure 2: The donor site of the dermis-fat graft

The deep layers of the donor site and the skin were closed with 4.0 poliglecaprone (Monocryl, monofilament, Ethicon US, LLL, Cincinnati, OH) or 4.0 polyglactin (Coated Vicryl, Ethicon US, LLL, Cincinnati, OH) interrupted sutures [Figure 3].

Then, by making conjunctival incision horizontally, endo-orbital tissues, bundles, and septa were all separated with blunt dissection. After sufficient opening was achieved in the socket, the graft was placed centrally in the anophthalmic socket, and then sutured to the Tenon's capsule and conjunctiva, using and 7-0 polyglactin (Coated Vicryl, Ethicon US, LLL, Cincinnati, OH) interrupted sutures, respectively [Figure 4]. A conformer was inserted into the socket and by placing tarsorrhaphy sutures, the eye was closed.

On the 10th postoperative day, the surface of the central part of the dermis-fat graft was covered with an oral mucosal graft and epithelialization was completed within two weeks with artificial tears [Figure 5].

Although the graft surface was epithelialized spontaneously, we routinely prefer to cover the dermis-fat graft surface with an oral mucosal graft. This also helps to camouflage the white, porous appearance of the dermis-fat graft, which has an uncomfortable appearance for the patient. After the operation, steroid and antibiotic drops (dexamethasone and moxifloxacin) were given to the patients four times a day. Systemic antibiotics and anti-inflammatory drugs (clavulanic acid/amoxicillin and naproxen sodium) were given daily for 1 week. The donor site care was also taken with betadine solution.

Patients started using the ocular prostheses 4 weeks after surgery. The mean postoperative follow-up period was 12.26 ± 1.13 months. Patients were followed up at 1-day, 1-week, 1-month, and 3-month intervals until the end of the 1st year. The integrity of dermis-fat graft, fornices depth, the presence of eyelid malposition, complications, prostheses stability, and position in the socket were carefully evaluated at each visit.

RESULTS

Dermis-fat graft was used for socket reconstruction in 34 patients, with a mean age of 40.3 ± 15.0 years (minimum 20 years and maximum 65 years). The extruded implant produced melting in the conjunctiva and sclera with a mean diameter of 11.6 ± 1.4 mm (range, 10–14 mm). Twenty-six (78.5%) of the extruded implants were porous and eight (23.5%) were acrylic.

The outcomes in secondary reconstruction of the anophthalmic socket with dermis-fat graft are shown in Table 2.

During the follow-up period, necrosis of the graft was developed in one (2.9%) patient. This is because of poor hygiene conditions of the patient and inappropriate use of medication following surgery. Purulent secretion and malodor in the socket were regressed with antibiotic treatment and recovered without surgical intervention. In 1(2.9%) of the patients, the graft was still not vascularized in the first month postoperatively [Figure 6].

In addition to secondary repair with dermis-fat graft, secondary surgical intervention was also required for fornix



Figure 3: Donor-site skin closure with 4/0 interrupted sutures

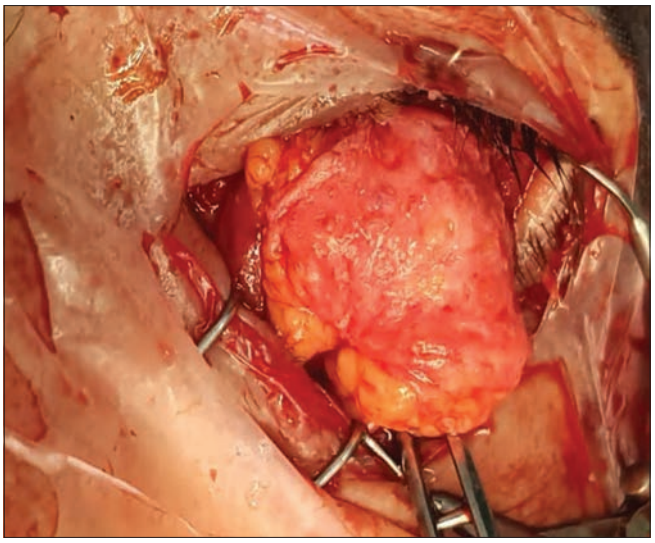


Figure 4: Insertion of the dermis-fat graft in the anophthalmic socket

reconstruction in two (5.8%) patients who had been previously operated as a result of a gunshot injury. Even though they were treated with mucous membrane graft and with copious lubrication, they did not wear prosthesis well.

In 2(5.8%) of our patients, due to their very thin structures, the thickness of the dermis-fat graft could not be obtained at the recommended thickness of minimum 2 cm, and graft shrinkage was observed at the postoperative 3rd month visit [Figure 7].

Only one (2.9%) patient was complaining of ptosis and deep superior sulcus [Figure 8]. Volume loss was compensated with dermis-fat graft by making standard upper blepharoplasty incision and tolerable improvement was achieved [Figure 9].

Cyst development was observed over the graft in one (2.9%) patient at the 1st year follow-up [Figure 10].

A donor-site necrosis was developed in two (5.8%) patients [Figure 11].



Figure 5: The surface of the dermis-fat graft was covered with an oral mucosa graft



Figure 7: Atrophy of the dermis-fat graft in a patient at the postoperative 3rd month visit

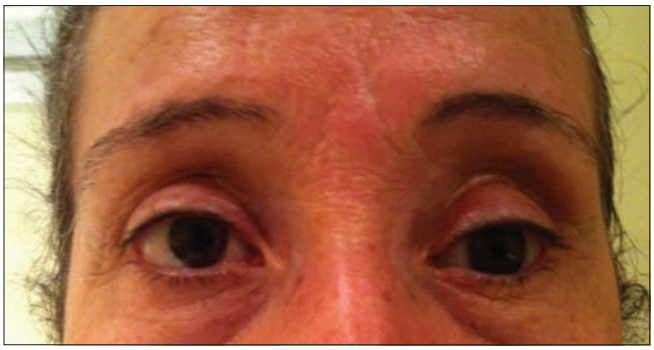


Figure 9: The appearance of the same patient at the postoperative 3rd month control



Figure 6: Insufficient vascularization of the graft seen in the postoperative 1st month visit

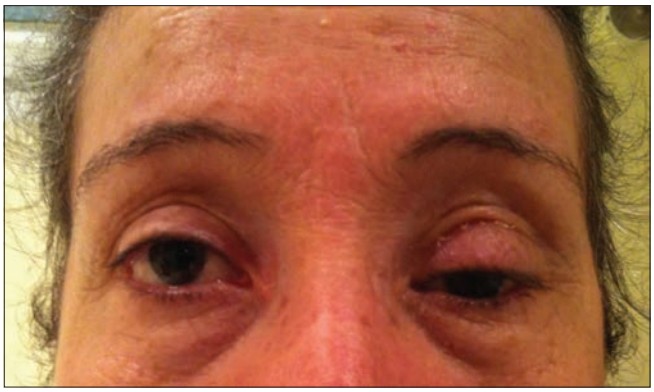


Figure 8: Patient with pseudoptosis and superior sulcus deformity, treated with dermis-fat graft following upper blepharoplasty incision



Figure 10: Cyst development seen over the graft at the 1st year control



Figure 11: The necrosis of the donor site

Table 2: The outcomes of dermis-fat graft in socket problems

Complications	*n* (%)
Graft necrosis	1 (2.9)
Insufficient vascularization of the graft	1 (2.9)
Fornix shortening	2 (5.8)
Graft shrinkage	2 (5.8)
Superior sulcus deformity	1 (2.9)
Pseudoptosis	2 (5.8)
Cyst over the graft	1 (2.9)
Donor-site necrosis	2 (5.8)

Except for two (5.8%) patients, all patients were satisfied with the result of dermis-fat graft and wore their prosthesis with 30° of horizontal and 15° of vertical mobility.

DISCUSSION

The dermis-fat graft is a safe and effective technique in the reconstruction of an exposed orbital implant with a large conjunctival defect, leading to severe signs of infection and scleral melting.[15]

The factors that are responsible for exposure can be listed as, the size of the implant, the rough surface, the depth of insertion, problems in closing the wound, or previously received radiotherapy and chemotherapy.[15] If the exposure area is small, it can be closed spontaneously, but if it is above 10 mm, autogenous or exogenous grafts are used. It is advised to use autogenous grafts, as exogenous grafts can cause immunological reactions and viral infection.[16,17]

Dermis-fat graft can also be used in primary enucleation cases, superior sulcus defects due to fat atrophy, enophthalmos, and contracted sockets.[1,18-20] The satisfaction rates of primary and secondary dermis-fat graft cases had been reported as 83% and 57%, respectively.[21,22] The disadvantages of dermis-fat graft is the increased risk of morbidity due to the formation of a second surgical wound (donor area).[1] In our study, there were 34 patients with a history of phthisic eye associated with penetrating trauma, who underwent evisceration surgery and had an orbital sphere implanted. In cases where the implant was extruded with a large conjunctival defect (>10 mm) with scleral melting, we performed dermis-fat graft for anophthalmic socket reconstruction because of its advantage of no foreign-body reaction and disease transmission. The success rate in the present study was 94.11%. Except for two patients, there was no complaint at the donor site in the gluteal region. In all our cases in which the dermis-fat graft surface was covered with a lip mucosal graft, there was a complaint of pain in the mouth only on the first day after the operation.

Surgical technique has been found to have an important role on implant exposure. Recent studies have focused on evisceration surgery techniques that allow a larger orbital implant to be placed behind the sclera, rather than radial sclerotomies. Implant exposure may occur as late as 18 or 20 months after surgery. Previous studies have pointed out that longer follow-up may reveal more cases of implant exposure.[23] In our study, we encountered exposure of the implant as a late postoperative complication, where we placed large orbital implants with radial sclerotomy technique and tightly sutured scleral flaps. In addition to surgical technique, we think that some changes such as discoloration, dullness, and roughness on the prosthesis surface of our patients, who wear the same ocular prosthesis for more than 8 years, may cause implant exposure by mechanical trauma.

In studies investigating the effect of implants with different materials and designs used in evisceration surgery, it was stated that nonporous implants have a high migration rate and integrated porous implants have a high exposure rate, while in another study, the material does not play a role in the extrusion of the implant.[23] In our study, only 8 of the 34 patients had acrylic implants, whereas others had synthetic implants (porous polyethylene implant). We did not make a distinction regarding implant exposure, but implant extrusion was mostly due to the surgical technique performed.

Graft necrosis is a serious adverse effect reported as 17.7%.[1,12,18] It is more common after secondary dermis-fat graft and is related to the technique of obtaining dermis-fat graft or implantation of dermis-fat graft in the orbit.[1]

A history of poor vascularization or socket contracture, chronic orbital inflammation, fat atrophy, and a history of previous severe orbital trauma due to postoperative

orbital volume loss or enucleation, multiple previous procedures, orbital radiotherapy, concomitant systemic vascular diseases (diabetes, hypertension, or others), immunosuppression, or coagulation problems are all predisposing factors for graft ulceration and necrosis.[1,24] Central necrosis occurs as a result of insufficient vascularization between the graft and the recipient bed. To prevent this, the graft must be well sutured to the conjunctiva and tenon at the dermis level.[1,14] In our study, we had one patient who had necrotic symptoms on the graft in the early postoperative period. This patient had a history of severely traumatized socket with late ocular surgery. We believe that the necrosis on the graft was due to poor hygienic conditions and inadequate use of medicine. She was successfully treated with appropriate antibiotics without the need for surgical intervention. In addition, one patient whose graft was not vascularized at the postoperative first month visit was diabetic and we think that this may be responsible for the insufficient vascularization between the graft and the recipient bed.

Atrophy or central necrosis may occur after a while as a result of large-tissue transplantation in patients with dermis-fat graft. Spontaneous graft atrophy is reported as 6–12.9% or even 40% of cases, so it is advised to take 30% larger than the defect measurement.[1,9,19-21,25,26] It has been stated that small grafts carry insufficient correction, and large grafts carry compression and ischemia-related central necrosis.[27] Graft thickness is also an important factor. In a study comparing grafts with 10- and 20-mm thickness, thicker ones were reported to be more successful.[26] In our study, graft shrinkage was observed only in two (5.8%) of our patients at the postoperative 3rd month visit. They had a very thin structure and the recommended minimum thickness of 2 cm dermis-fat graft could not be obtained. Another reported complication with dermis-fat graft is cyst formation on the graft, which are the epithelial islands remaining on the graft during preparation.[1,18] In our study, we had only one patient with cysts over the dermis-fat graft, which was observed as a late sign.

Other reported postoperative complications of dermis-fat graft include hair growth on the graft, wound dehiscence in the donor area, hematoma, and keratinization of the socket.[1,12,28]

Epidermis dissection should be done carefully in order to prevent hair growth on the anterior surface of the graft, formation of conjunctival cysts, or granulomas.[29] In our study, necrosis at the donor site was developed in two (5.8%) patients. There was no hair growth on the graft in any of our patients.

The integrity of the conjunctiva is very important for a healthy socket. Previous multiple surgeries cause cicatrization of the conjunctiva, creating a risk factor for implant exposure.[23,30] In our study, except two patients with inadequate fornix, who had a history of undergoing operation due to gunshot ocular injury, were gone to secondary repair with dermis-fat graft and also secondary surgical intervention for fornix reconstruction, all patients were able to wear their ocular prosthesis well.

Ptosis after anophthalmic socket reconstruction is not a true ptosis. This type of ptosis is usually caused by a lack of orbital volume, and microphthalmus, enophthalmos, phthisis bulbi, or improper use of prosthesis.[22] In our study, we had two patients with pseudoptosis, and one patient complained of deep superior sulcus. In this patient who was operated for the deep superior sulcus, a dermis-fat graft was placed in the sulcus with a blepharoplasty incision. Although there was a resorption in the size of the graft with time, the patient had tolerable cosmetic result.

CONCLUSION

Dermis-fat graft is an effective way to overcome problems related to implant exposure, with low morbidity and a satisfactory cosmetic result. Complications such as graft necrosis or lid deformities are rare, and the cosmetic and functional results are favorable. However, it should be kept in mind that necrosis may develop at the donor site and care should be taken in its treatment.

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Statement of ethics

The study protocol was approved by the Ethics Committee of Kartal, Lutfi Kirdar Education and Research Hospital, Istanbul, Turkey (decision number: 2020/514/181/6).

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Conflicts of interest

There are no conflicts of interest.

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Original Article

Comparative study of sutureless and glue-free versus conjunctival autograft with sutures in primary pterygium surgery

ABSTRACT

Context: Sutureless glue-less surgery (SGF) is a newer alternative to the conventional conjunctival autograft with sutures (CAGS) techniques used for pterygium surgery. **Aims and Objectives:** To compare the safety, efficacy, and complications of SGF technique versus CAGS in the management of primary pterygium. **Subjects and Methods** We performed a hospital based prospective study among 46 patients who underwent pterygium excision during an 18-month period from 2017 to 2018. **Results:** The duration of SGF procedure was <15 min with fewer incidences of overall symptoms postoperatively ($P < 0.001$) which were significantly higher in the CAGS group. The duration of symptoms was 4 days for SGF and 4 weeks for CAGS group. Although signs like graft edema and retraction were more in the SGF group in the immediate postoperative period, it resolved by 6 weeks. Three cases of recurrence were noted in the SGF group, but this was statistically insignificant. No graft loss occurred. Paired t-test showed that there is a significant reduction in astigmatism and improvement in keratometric values in both groups, with greater change in SGF group, however, this was not statistically significant. **Conclusion:** Sutureless and glue-free technique is a safe, effective, time-saving, and economical option for the management of pterygium with less postoperative symptoms. SGF has more postoperative signs which resolved in 6 months. The recurrence rate was higher in SGF but within the expected range reported in the literature.

Keywords: Astigmatism, conjunctival autograft with sutures, graft uptake, pterygium surgery, sutureless and glue free

INTRODUCTION

Pterygium is a "wing-like" growth consisting of conjunctival epithelium and hypertrophied subconjunctival connective tissue.[1] Symptoms range from ocular surface irritation to decreased vision from astigmatism and visual axis obscuration.

There are many treatment methods currently in practice, both surgical and medical. Failure in treatment is often due to our lack of understanding of real pathogenesis, and its propensity for recurrence.

The conventional methods of sutured or glue fixation of autograft has complications and there is a trend towards use of sutureless and glue-free (SGF) grafting. Therefore, a comparative study would throw light on the two techniques, comparing their merits and demerits.

SUBJECTS AND METHODS

Study population

Ours was a prospective study of 48 patients who had attended the outpatient department of ophthalmology during

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an 18-month period. This included subjects undergoing pterygium excision from our college. Patient inclusion criteria were aged <18 years of either sex, unilateral and primary pterygium. Those with pseudopterygium, ocular surface infections, history of pterygium surgery, any bleeding abnormalities and anti-coagulant therapy were excluded from the study.

Approval for study protocol was granted by the Hospital Institutional Review Board comprising of Ethical and Research Committee. Written informed consent was obtained from all the patients.

Study measurements

Consecutive patients were selected, detailed demographics and ocular evaluation were recorded. Type of pterygium, location, size, and extent onto the cornea were noted. Other significant ocular history and examination findings were also recorded (i.e., visual acuity assessment, retinoscopy, refraction, keratometry, and fundus examination). Blood pressure and random blood sugar were also checked prior to surgery.

Two surgeons at the study institute performed the SGF techniques based on their experience and expertise while the remaining surgeons performed conjunctival autografts with sutures (CAGS).

Relevant intraoperative data collected included technique of surgery, type of conjunctival autografting, number of sutures, suture material used, and duration of surgery.

Postoperative follow-up was done at Day 1, Week 1, 1-month, and 6-months. Patient's comfort level, symptoms if any, visual acuity and keratometric values were recorded. Slit-lamp examination to assess for subconjunctival hemorrhage, graft stability, graft uptake, graft retraction, corneal surface, and donor area was done. All these parameters along with refraction, keratometric values, and recurrence of the pterygium were recorded at 1-month and 6 months. Further, appropriate statistical method was used to analyze the collected data.

Surgical technique was systematically followed in all cases under strict aseptic precautions. The eye was thoroughly cleaned and draped. Povidone-iodine 5% eye drops were instilled in the conjunctival sac and washed. All surgeries were done under topical anesthesia with lignocaine 4%. Eye speculum placed. Pterygium was dissected from cornea with No. 15 Bard-Parker blade then separated from underlying sclera and excised. Remaining subconjunctival degenerative part of pterygium was excised with Westcott scissor. Corneal and limbal surfaces were smoothed by scraping using Tooke's knife or Bard-Parker blade. Cautery was avoided. The bare scleral area was measured with Castroviejo calipers. For harvesting conjunctival autograft, the eyeball was rotated down and in. The calipers were dipped in trypan blue dye and an area measuring 1 mm greater than the bare sclera was demarcated. In superotemporal bulbar conjunctiva 1cc of the local anesthetic, lignocaine was injected to facilitate separation of conjunctiva from Tenon's capsule. Blunt dissection of the conjunctiva was carried out using Westcott scissors. Autograft was cut and gently slid into place over the bare sclera in its correct anatomical orientation.

For patients in the CAGS group, four interrupted sutures were used at all four corners of the graft with 10-0 nylon. If the graft was long, 1–2 more sutures were applied. In SGF group, no suture was used. Hemostasis was allowed to occur spontaneously without cautery to provide autologous fibrin to glue the graft naturally in position. Ironing of graft was done with iris repositor. After making host conjunctiva as envelop, graft was placed beneath it. Scleral bed was viewed through transparent conjunctiva to ensure residual bleeding does not relift the graft. The patient was then asked to adduct or abduct his/her eye to see whether the graft remained in place with ocular movements. If adherence was satisfactory, speculum was removed carefully. Eye was patched for 24 h.

Postoperatively, patients were given antibiotic steroid combination of moxifloxacin and dexamethasone eye drops (six times for 1st week and then in tapering doses over 1 month) and lubricating eye drops (0.5% carboxy methyl cellulose sodium eye drop four times a day for 1 week in SGF cases and for 1 month in CAGS cases). Patients were instructed to avoid rubbing their eyes. Postoperatively, all patients were asked to come for follow-up at Day 1, Week 1, 1-month and V6-months for evaluating graft apposition, keratometry and recurrence. Sutures were removed after 1 month.

The primary outcomes of interest were postoperative discomforts like pain, foreign body sensation, photophobia, and signs such as hyperemia, chemosis, graft dehiscence, graft retraction, or graft loss. The secondary outcomes of interest included the duration of surgery and postoperative complications.

Statistical analysis

Descriptive statistical tools (frequency, percentage, mean, Standard deviation [SD]) and Inferential statistical

tools (*t*-test, Chi-square test, analysis of variance) were used. SPSS version 24 (SPSS Inc., Chicago, IL, USA) was used to analyze the data. $P < 0.05$ was considered statistically significant. Paired and independent *t*-test were used to compare the outcomes.

RESULTS

Forty-eight patients were initially enlisted out of which two did not meet the inclusion criteria. A total of 46 patients were selected for the purpose of this study.

Patients belonged predominantly to the age group of 61–80 years, (mean ± SD; 60.58 ± 12.8). Mean age in SGF group was 57.35 years and in the CAGS group was 64.7 years. Lower and upper limits for age were 23 years and 86 years, respectively.

We noted a female predominance 27 (59%), of which 18 belonged to SGF group and 9 to CAGS group. Male patients were 19 (41%), of which 7 belonged to SGF group and 12 to CAGS group. Surgical techniques used were SGF in 25 (54%) cases and CAGS in 21 cases (46%).

Pterygia were predominantly on the nasal region, 37 cases (80%) and rest 9 cases (20%) on the temporal region. Of these nasal pterygia, 21 were excised and autografted by SGF technique and 16 underwent CAGS; of the temporal pterygia, 4 had SGF technique and 5 had CAGS technique.

Of the 25 cases in the SGF group, 12 pterygia were encroaching upto one-third of the area of the cornea between limbus and pupillary margin; 12 between one-third and two-third of the area and one crossed the pupillary margin. Of the 21 cases in the CAGS group, 11 pterygia were encroaching up to one-third of the area of the cornea between limbus and pupillary margin; 10 between one-third and two-third of the area and none crossed the pupillary margin.

The duration of SGF procedure was less compared to CAGS technique [Table 1].

Table 1: Duration of surgery

Duration (min)	SGF (*n*=25), *n* (%)	CAGS (*n*=21), *n* (%)
<15	21 (84)	0
15-30	4 (16)	0
30-45	0	2 (9.52)
45-60	0	18 (85.71)
>60	0	1 (4.76)

SGF - Sutureless glue-free, CAGS - Conjunctival autografts with sutures

The only postoperative symptom noted in the SGF group was redness while a significant number of CAGS cases had other symptoms like foreign body sensation

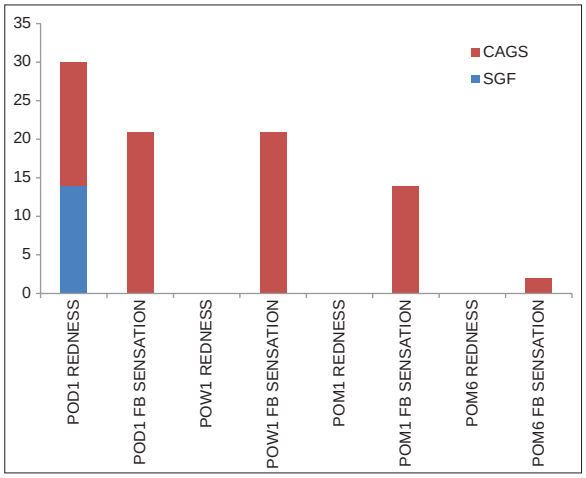


Figure 1: Postoperative symptoms

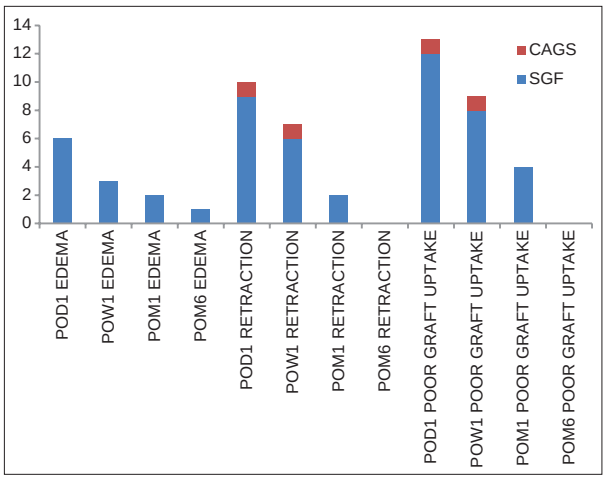


Figure 2: Slit lamp findings in postoperative days

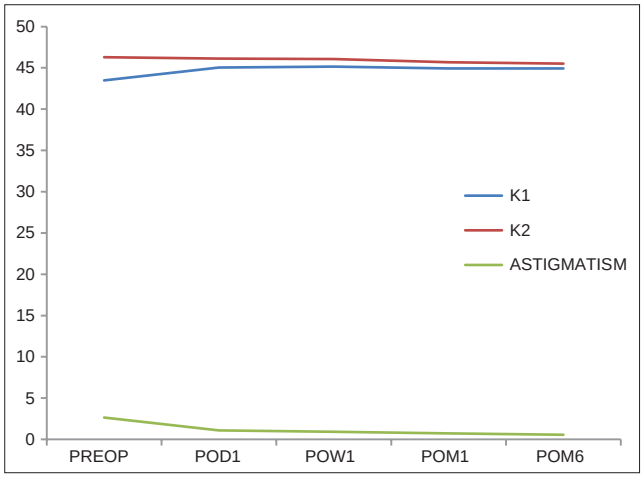


Figure 3: Trend of keratometry and astigmatism following sutureless and glue-free procedure

and epiphora [Figure 1]. Further, patients underwent through postoperative slit-lamp examination at each follow-up [Figure 2 and Table 2].

There was a significant reduction in astigmatism and improvement in keratometric values in both the groups; but was more in the SGF group, however, this was not statistically significant [Figures 3, 4 and Tables 3, 4].

Final graft uptake was satisfactory in both the groups [Figures 5 and 6].

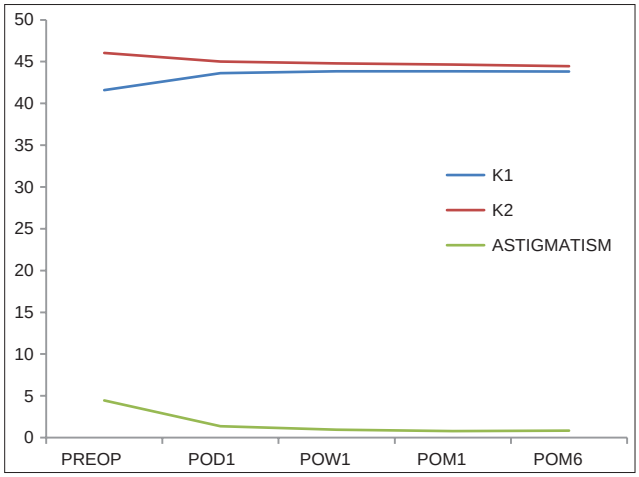


Figure 4: Trend of keratometry and astigmatism following cags procedure

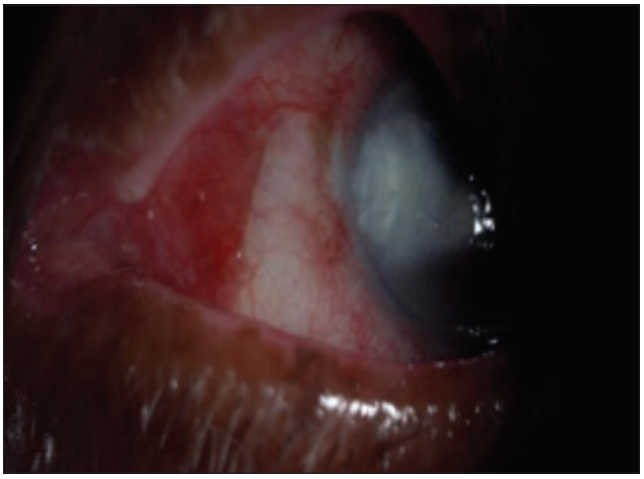


Figure 5: LE–Pod1 photograph showing good graft apposition following sutureless and glue-free conjunctival autografting

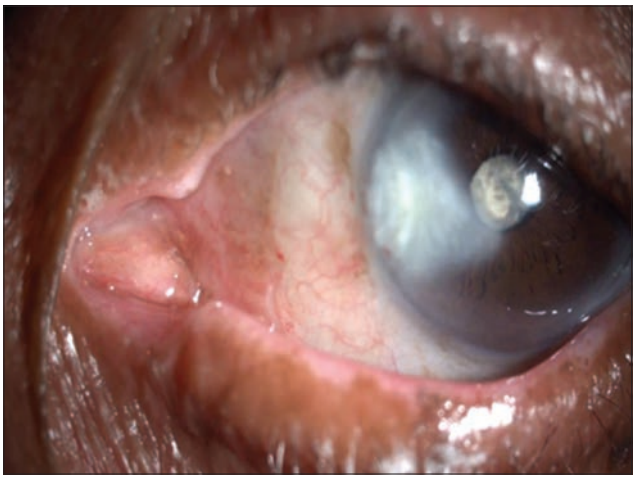


Figure 6: LE–Pow1 photograph of the same patient showing good graft uptake

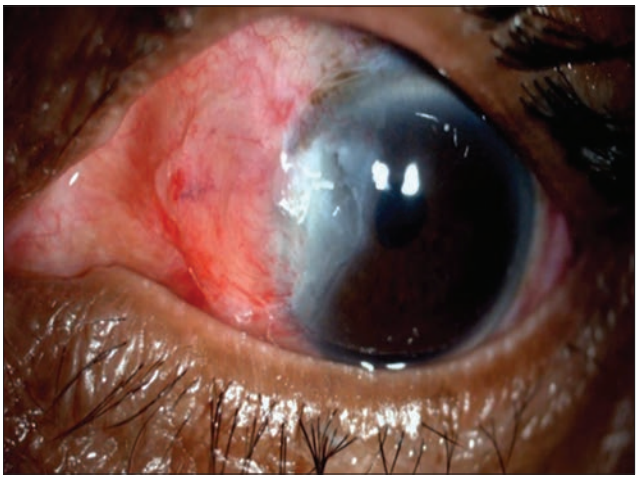


Figure 7: LE–Pod1 photograph showing mild graft edema following sutureless and glue-free procedure

Table 2: Analysis of slit lamp findings

Determinants	Percentage		Odds		Pearson's χ^2		*P*	
	CAGS	SGF	CAGS	SGF	CAGS	SGF	CAGS	SGF
Graft edema								
POD1	0	24	0	Undefined	5.78	5.78	0.016	0.016
Graft retraction								
POD1	5	36	0.08	11.4	6.56	6.56	0.01	0.01
POM1	5	36	0.08	11.4	6.56	6.56	0.01	0.01
Good graft uptake								
POD1	95	50	19	0.05	10.6	10.6	0.001	0.001
POW1	95	67	9	0.1	5.38	5.38	0.02	0.02

SGF - Sutureless glue-free, CAGS - Conjunctival autografts with sutures



Figure 8: LE–Pom 1 photograph showing resolved graft edema and good graft uptake

The postoperative astigmatism did not differ significantly between the two surgical groups at follow up on day 1 ($P = 0.410$), week 1 ($P = 0.923$), and 1 month ($P = 0.736$) and 6 months ($P = 0.618$).

DISCUSSION

Conventional surgical procedures have favorable outcomes. Surgeons however are exploring various alternatives that can further reduce postoperative discomfort and recurrence. Limbal conjunctival autograft has a low recurrence and complication rate, but is more technically demanding, complex, time-consuming and can result in limbal stem cell deficiency of the donor site.[2,3]

Symptoms such as foreign body sensation, redness, and epiphora were much less in sutureless glue-free group as compared to CAGS group. The severity of symptoms was maximum at the first postoperative day for both the groups; this lasted up to 4 days in the SGF group compared to 4 weeks in CAGS group.

Natung *et al*. and various authors. had similar observations in his study.[4-6]

Ashok *et al*. reported postoperative symptoms in 5 (20%) patients in SGF group and 20 (80%) patients in sutured group.[7] We noted results similar to Elwan who showed that postoperative signs and symptoms were significantly lower in the first postoperative month as well as significantly higher overall patient satisfaction in sutureless compared to sutured autograft.[8]

Graft edema was reported more in the SGF group in the immediate postoperative period [Figure 7]. This may be because advanced pterygia were noted more in the SGF group. Edema resolved between 1 and 6 weeks' period [Figure 8]. This is consistent with a previous study that reported 16% edema in the sutureless glue-free group and 6% edema in the sutured group respectively.[4] Sharma *et al*. also reported graft edema in 2 (8%) eyes in SGF group and 3 (12%) eyes in sutured group which resolved after 1 week.[7]

There was slight graft retraction in the area away from the limbal margin in few cases of SGF and one case in CAGS group. Overall, no cases of graft loss occurred. No active intervention was instituted and the exposed area epithelialized adequately on follow-up without compromising surgical or cosmetic

Table 3: Independent *t*-test analysis comparing outcomes of keratometry and astigmatism in conjunctival autografts with sutures and sutureless glue-free procedure

Procedure	Mean	Mean difference	*P*
POD1K1			
CAGS	43.5750	−2.206	0.033
SGF	44.5625		
POD1K2			
CAGS	45.0250	−1.476	0.002
SGF	45.7292		
POD1AST			
CAGS	1.4500	0.832	0.410
SGF	1.1667		
POW1K1			
CAGS	43.8100	−1.717	0.093
SGF	44.6042		
POW1K2			
CAGS	44.8125	−1.544	0.130
SGF	45.5833		
POW1AST			
CAGS	0.9875	0.097	0.923
SGF	0.9583		
POM1K1			
CAGS	43.8225	−1.549	0.129
SGF	44.5000		
POM1K2			
CAGS	44.6500	−1.263	0.214
SGF	45.2500		
POM1AST			
CAGS	0.8250	0.339	0.736
SGF	0.7500		
POM6K1			
CAGS	43.7725	−1.063	0.294
SGF	44.3333		
POM6K2			
CAGS	44.4500	−1.580	0.122
SGF	45.1458		
POM6AST			
CAGS	0.88	−0.503	0.618
SGF	0.83		

SGF - Sutureless glue-free, CAGS - Conjunctival autografts with sutures

Table 4: Paired *t*-test analysis of keratometry and astigmatism in sutureless glue-free and conjunctival autografts with sutures procedure

	Mean difference		SD		Significant (two-tailed)	
	CAGS	SGF	CAGS	SGF	CAGS	SGF
Pair 1						
BSK1-POD1K1	−2.17500	−1.94792	2.64836	2.35559	0.002	0.000
Pair 2						
BSK1-POW1K1	−2.41000	−1.98958	2.55057	2.33299	0.000	0.000
Pair 3						
BSK1-POM1K1	−2.42250	−1.88542	2.61028	2.26382	0.001	0.000
Pair 4						
BSK1-POM6 K1	−2.37250	−1.71875	2.63581	2.43537	0.001	0.002
Pair 5						
BSK2-POD1K2	1.05000	0.19792	2.01410	0.87532	0.031	0.279
Pair 6						
BSK2-POW1K2	1.26250	0.34375	2.13596	0.83670	0.016	0.056
Pair 7						
BSK2-POM1K2	1.42500	0.67708	2.26254	0.90133	0.011	0.001
Pair 8						
BSK2-POM6K2	1.62500	0.78125	2.30774	1.02499	0.005	0.001
Pair 9						
BSAST-POD1AST	3.21250	2.22917	2.70632	2.96988	0.000	0.001
Pair 10						
BSAST-POW1AST	3.67500	2.43750	2.94031	3.07183	0.000	0.001
Pair 11						
BSAST-POM1AST	3.83750	2.64583	3.08143	3.13285	0.000	0.000
Pair 12						
BSAST-POM6AST	3.98750	2.57292	3.04622	3.43929	0.000	0.001

SGF - Sutureless glue-free, CAGS - Conjunctival autografts with sutures, SD - Standard deviation

results. The donor site also re-epithelialized completely within few days after surgery. In the study by Natung *et al*., graft stability was better in sutured group[4] Boucher *et al*., reported 15% graft loss in the sutureless glue-free group. We found similar results with graft retraction more common in the SGF group.[9] In Dr. Mitra's study of 19 patients, two patients experienced a medial edge recession.[10]

In our study, we noted 3 cases (6.8%) of recurrence which occurred in the SGF group within 6 months after surgery; but it was statistically insignificant in terms of method of autografting. The recurrence rate in our study is consistent with previous studies that have reported recurrence rates from 16% to 39% in high-risk populations and 2.5%–10% in all grades of pterygium.[11,12]

Natung *et al*. reported that at 6 months, 4 (26.6%) patients in SGF group had recurrence whereas, in the sutured group, five patients (33.3%) had recurrence, the difference of which again was not statistically significant ($P = 0.446$).[4] Choudhury *et al*. and Sati *et al*., also found equal recurrence rate in their studies.[13,14] As per their study, sutures do not incite more inflammation than the nonsuture groups as postoperative steroids take care of the postoperative inflammation. According to them it is the barrier effect of conjunctival autograft that plays an important role in preventing recurrences. Therefore, comparing a suture group with *in situ* blood coagulum group is justified. Meanwhile de Wit *et al*., reported no recurrence in 15 eyes within a mean follow up period of 9.2 months.[15]

Analysis shows that there is a significant reduction in astigmatism and improvement in keratometric values in both SGF and CAGS groups. However, in our study, the reduction is more in the SGF group, but it was not statistically significant.

Altan-Yaycioglu *et al*. in his study found out that there is a significant correlation between the pre and postoperative astigmatic values ($\rho = 0.351$).[16] Some studies show no correlation between these two parameters.[17,18] Similar to our results, Wu *et al*. identified significant correlation between differences in refractive cylindrical power before and after surgery.[19]

There are only limited studies comparing the effect of different surgical approaches on astigmatism. Yilmaz *et al*. compared astigmatic changes following different types of surgeries including conjunctival autografting, limbal-conjunctival

autograft, baresclera and baresclera with mitomycin.[20] The authors found a statistical difference between groups for mean topographical astigmatism and surgically-induced astigmatism ($P = 0.033$ and 0.030, respectively).

Fibrin glue is effective to attach the conjunctival autograft in pterygium surgeries,[21-23] but has the risk of transmission of human infection of parvovirus B19 and hepatitis b virus,[24,25] is costly and cannot be afforded by patients from poor socio-economic status. Autologous blood has advantages in that the procedure is easy to perform with shorter duration, less overall discomfort and economical for the patient and the disadvantage is uncertainty about graft retention, position, and loss which is comparatively rare.

There are several limitations to our study that limit generalization to a larger population. The follow-up period is short and a longer follow-up period of a year or more may help us understand the long-term sequelae and performance of the graft. The study was not a randomized intervention trial and patient groups were determined by the experience of the surgeon in performing the procedure. Further studies with a larger sample size, longer duration of follow up and the use of medications like mitomycin C will give further insight into the management of pterygium.

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There are no conflicts of interest.

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Original Article

The incidence of retinopathy of prematurity and the common risk factors associated with it: A retrospective study in a tertiary care center in Central Kerala

ABSTRACT

Aim: The aim of this study is to determine the incidence and risk factors for retinopathy of prematurity (ROP) among newborn babies screened at a public sector teaching hospital in Central Kerala. **Materials and Methods:** A retrospective case record-based study that included all newborns screened at the study center from May 2015 to May 2017. Newborn babies with significant media opacities and missing data were excluded from this study. A detailed ophthalmic assessment was done and association of ROP with maternal and perinatal risk factors was assessed. **Results:** Thirty-nine (6.9%, 95% confidence interval [CI]: 5.02, 9.23) of the 565 newborns screened at the department had ROP. This included 14 (2.48%) babies with Stage 1, 17 (3.01%) babies with Stage 2, and 8 (1.42%) babies with plus disease. Placenta previa or abruption (odds ratio [OR] 3.72, 95% CI: 1.32, 10.52), Respiratory distress syndrome (OR: 2.05, 95% CI: 1.05, 4.01) and hyaline membrane disease (OR: 4.19, 95% CI: 1.96, 8.99), a birth weight <2500 g (adjusted OR: 5.06, 95% CI: 1.20, 21.32) were associated with ROP. The risk of ROP reduced significantly with every unit increase of birth weight in a linear regression model (coefficient = –511.5, R^2 = 0.03). **Conclusion:** The incidence of ROP is lower in this study population compared to reports from other areas of India. The significant associations with birth weight and gestational age are important as global preterm births are increasing and may possibly lead to an epidemic of ROP More ophthalmologists must be trained in the management of ROP and integrated with neonatal intensive care services.

Keywords: Gestational age, retinopathy of prematurity, risk factors

INTRODUCTION

Retinopathy of prematurity (ROP) is a sight-threatening developmental disorder of the retinal blood vessels that is more common in premature and low birth weight infants.[1] Early identification and intervention can preserve sight in these infants, but the disease often goes unnoticed in the early weeks of life. Most of the visually impaired survivors are born in middle-income countries of the world.[2-4] Improvements in neonatal care and resuscitation have led to the survival of more preterm babies in India and ROP is emerging as a significant cause of visual disability in children.[4]

India has the largest number of premature babies and hence high incidence of ROP among developed countries.[4] India accounts for nearly 10% of the worldwide estimate of blindness and visual impairment due to ROP and >3000 infants become visually impaired each year due to lack of screening and treatment for ROP.[4] A previous study from Kerala reported an incidence of 25.4% ROP among babies admitted to neonatal intensive care units (NICUs) and 9.8% needed laser treatment.[5] Several studies including

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the CRYO ROP study have reported gestational age (GA) and birth weight as strongest risk factors for ROP.[6-9] Several other risk factors including the use of supplemental oxygen, maternal factors, antenatal and perinatal factors, and postnatal infantile factors have been reported.[10] However, ROP in India, including the severe forms are seen in more mature babies with higher birth weights as well.[11,12] We designed a retrospective case record-based study to identify the incidence and common risk factors associated with ROP among the newborn babies screened over 2 years in a tertiary care hospital in Central Kerala.

MATERIALS AND METHODS

The study protocol was approved by the Institutional Ethics Committee. Case records over a period of 2 years from May 2015 to May 2017 at the study institute were considered for inclusion. Case records of newborn babies screened at the Ophthalmology Department were identified from the registry for ROP screening at the study institute. Newborn babies with a GA ≤34 weeks, birth weight ≤2000 g were referred for ROP screening. In addition, any newborn baby with a GA >34 weeks with the presence of any risk factor for ROP, or if there was a clinical suspicion of ROP were referred by the neonatologist for screening. Newborn babies with significant media opacity such as congenital cataract and glaucoma, or with incomplete childbirth or perinatal details were excluded from the study.

We retrieved information of the various antenatal and postnatal factors from the case records and entered them into a data collection form after anonymizing individual patient information.

Details of maternal factors including age, parity, type of delivery, multiple pregnancies, obstetric complications such as pregnancy-induced hypertension (PIH), gestational diabetes mellitus (GDM), antepartum hemorrhage (abruption placenta/placenta praevia), febrile illness, and premature rupture of membrane (PROM) were collected from the case records. Details of childbirth and postnatal period including GA, birth weight, sex, asphyxia, oxygen supplementation, presence of sepsis, and metabolic derangements such as hyperglycemia. Hypoglycemia, hyperbilirubinemia, hypocalcemia, and ABO/Rh incompatibility were recorded. GA was recorded in case sheet as per protocol (determined by antenatal ultrasound in the first trimester and calendar method) was taken. Birth weight was recorded by electronic weighing scales. Oxygen supplementation was provided based on hospital NICU guidelines and involves low flow divert through nasal prongs and hoods. Details of high supplementation with continuous positive airway pressure and ventilator were noted. Diagnosis of sepsis was recorded by clinical suspicion, diagnostic tests, and microbiological confirmation.

All ophthalmic assessments were done by trained ophthalmologists within 30 days of life.

Anterior segment assessments were done to look for pupillary dilation, lenticular changes, and media clarity followed by posterior pole and peripheral examinations of all clock hours to look for presence, vascularization, and zone and stage of ROP. Posterior segment assessments were done after dilatation using 1% tropicamide and 2.5% phenylephrine eye drops diluted to 50% with preservative-free lubricants and applied 10 min apart starting 1 h before the examination. Indirect ophthalmoscope and a 20D lens were used to assess the fundus after instilling topical anesthesia drops and with the help of a pediatric eye speculum and scleral depressor. The diagnosis and classification of ROP were based on the International Classification of ROP guidelines.[13] All babies were categorized as no ROP, Stage 1 to 5 ROP and plus disease. The worse affected eye was used to categorize the stage and severity of ROP. If both eyes were symmetrically affected, the right eye was chosen to determine stage and severity. Newborn babies with severe ROP were assessed at 3–5-day intervals, those with less than severe ROP at weekly intervals, and those with no ROP at bi-weekly intervals till complete retinal vascularization was noted.

Data were initially entered into an MS Excel spreadsheet and exported to the SPSS software for statistical analysis IBM SPSS Statistics. Continuous variables were expressed as mean standard deviation (SD) and categorical variables were expressed as proportions. The incidence of ROP was described as a proportion. Risk factors associated with ROP were initially explored using a bivariate analysis using a one-way analysis of variance test and Fisher's exact test. Significant associations with ROP are presented as odds ratio (OR) and 95% confidence intervals (CIs) around the point estimate. $P < 0.05$ was considered as statistically significant.

RESULTS

The study included 565 newborn babies that were screened for ROP at the study institute. Table 1 presents the maternal details of the newborn babies that were screened. PIH (n = 85, 15.04%) and gestational diabetes mellitus (n = 65, 11.50%) were the most common maternal comorbid conditions [Table 1], abnormal liquor volume was noted in 71 (12.57%) and PROM in 98 (17.35%) mothers. A cesarean section was performed on 332 (58.87%) women.

Twenty-one (3.72%) babies were born ≤28 weeks of gestation, 118 (20.92%) babies were born between 28 and

32 weeks of gestation and 108 (31.95%) babies were born between 32 and 37 gestation weeks. Three hundred and eleven (55.04%) babies were male. The mean (SD) birth weight of the babies screened for ROP was 1,884.71 (737.87) with an interquartile range of 1430–2200 g. Most of the babies (n = 558, 98.76%) were admitted to the NICU. The neonatal details of the 565 babies screened for ROP are presented in Table 2.

Thirty-nine (6.9%, 95% CI: 5.02, 9.23) of the 565 newborns screened at the department had ROP. This included 14 (2.48%) babies with Stage 1, 17 (3.01%) babies with Stage 2, and 8 (1.42%) babies with plus disease. Table 3 presents the association of ROP with maternal factors. None of the mothers with GDM had a baby with ROP in this series and placenta previa or abruption was associated with an increased risk for ROP (OR 3.72, 95% CI: 1.32, 10.52). The association of ROP with postnatal and childbirth factors is presented in Table 4. Respiratory distress syndrome (OR: 2.05, 95% CI: 1.05, 4.01) and hyaline membrane disease (OR: 4.19, 95% CI: 1.96, 8.99) were associated with ROP. ROP was significantly associated with a birth weight <2500 g (adjusted OR: 5.06, 95% CI: 1.20, 21.32) and the risk of ROP reduced significantly with every unit increase of birth weight in a linear regression model (coefficient = –511.5, R^2 = 0.03).

DISCUSSION

Nearly one in 10 newborn babies screened had ROP in this series. ROP was significantly associated with birth weight, abnormal placentation, respiratory distress syndrome, and hyaline membrane disease in this study. Gestational diabetes showed a protective effect for the development of ROP.

An estimated 0.2% of childhood blindness is attributed to ROP with the prevalence ranging from 0.81/1000 to 1.5/1000 in different states.[14,15] The KIDROP study from Karnataka in 2015 reported an incidence of any-ROP to be 22.4% with an incidence of 3.5% for severe-ROP requiring treatment.[16] The twin cities ROP project reported any-ROP in 25% of 643 babies screened,[17] while an incidence of 21.6%–32, 0.6% was reported from other studies. The incidence of ROP in our study population (6.9%, 95% CI: 5.02, 9.23) is lower than the estimates reported from other parts of India. The incidence is lower than the 25% reported from a previous study from NICUs in Kerala[5] but the lower incidence of ROP in the screened population may reflect the criteria used to refer newborn babies for screening. The incidence of ROP was 14.7% (95% CI 7.84, 20.50%) in the study population with GA <32 weeks and birth weight <1700 g. Nineteen (6.13%) of the newborn babies between 34 and 36 weeks that were screened had ROP. These babies may have been missed if we had used a strict <32 weeks GA criteria. Only 2 (1.12%) newborn babies with a birth weight >2000 g developed ROP. Compliance with the revised screening guidelines for ROP in India may help minimize the number of preterm babies screened for ROP.

Table 1: Maternal characteristics of the newborn babies screened for retinopathy of prematurity

Characteristic	*N* (%)
Mean (SD) maternal age in years	27.11 (5.08)
Primigravid	103 (18.23)
Fever and rash	19 (3.36)
Anemia	13 (2.30)
Pregnancy induced hypertension	85 (15.04)
Gestational diabetes	65 (11.50)
Preeclampsia/eclampsia	39 (6.90)
Placenta previa/abruption	25 (4.42)
Abnormal liquor volume	71 (12.57)
PROM	98 (17.35)
Normal vaginal delivery	232 (41.13)

PROM Premature rupture of membrane, SD – Standard deviation

Table 2: Neonatal details of the 565 newborn babies screened for retinopathy of prematurity

Factors	*N* (%)
Supplemental oxygen	347 (61.42)
Continuous positive airway pressure	103 (18.23)
Ventilation	19 (3.36)
Hypoglycemia	23 (4.09)
Hyperglycemia	1 (0.18)
Hyperbilirubinemia	186 (32.92)
Hypocalcemia	11 (1.95)
Respiratory distress syndrome	254 (44.96)
Sepsis	160 (28.32)
ABO/Rh incompatibility	40 (7.08)
Hyaline membrane disease	56 (9.91)
Birth weight<2000 g	376 (57.32)

Table 3: Association of retinopathy of prematurity with maternal factors in the screened population

Factors	*P* (Fisher's exact test)
Maternal age	F=0.25, P=0.62 (one-way ANOVA)
Parity	0.25
Fever and rashes	0.64
Anemia	0.99
Pregnancy-induced hypertension	0.99
GDM	0.02
Preeclampsia/eclampsia	0.18
Placenta previa/abruption	0.01
PROM	0.124
Abnormal liquor volume	0.81

GDM Gestational diabetes mellitus, PROM Premature rupture of membrane

Table 4: Association of retinopathy of prematurity with childbirth and postnatal factors

Factors	*P* (Fisher's exact test)
Mode of delivery	0.98
Sex of the baby	0.65
NICU care	0.46
Supplemental oxygen therapy	0.21
Neonatal hypoglycemia	0.22
Neonatal hyperglycemia	0.78
Neonatal hyperbirubinemia	0.68
Sepsis	0.36
Neonatal hypocalcemia	0.36
ABO/the incompatibility	0.07

NICU – Neonatal intensive care unit

Several risk factors are reported for ROP.[7-12] A previous study from Kerala reported anemia, oxygen administration, hours on ventilation, and blood transfusion as significant risk factors for ROP.[5] However, only birth weight, abnormal placentation, respiratory distress syndrome and hyaline membrane disease, and GA at birth were significant risk factors in our study. ROP was not associated with supplemental oxygen therapy in this study and maybe associated with the pattern of oxygen supplementation. A previous meta-analysis has reported that early low and late high oxygen saturation was associated with a reduced risk for severe ROP among preterm infants with a GA of <or = 32 weeks.[18] Abnormal placentation was a risk factor for ROP in this study population. A previous study has reported on the higher incidence of ROP even in infants with birth weights exceeding the usual screening criteria in childbirths complicated by severe prenatal blood loss requiring blood transfusions and surgery.[19] Population differences in the risk factors for ROP that affect severity and progression of the disease are well recognized.[2,4,10]

The documentation and detailed ophthalmic assessments integrated with neonatal assessments at a tertiary care center may be considered as strengths of the study. The retrospective nature of the study maybe a limitation as standardization between observers was not possible. The single-center nature of the study can also be considered a limitation as the results may not be generalizable to a larger population.

The results of this study from a public sector teaching hospital add to the existing knowledge pool available on ROP in India. The difference in risk factors and the lower incidence in the screened population may reflect differences in the study population and screening criteria. The results of the study, however, highlight the need for studies from different areas and health-care settings in Kerala to obtain reliable estimates of the incidence and risk factors for ROP. Global preterm births are increasing worldwide including in India[20] and will lead to an increased number of newborn babies that need ophthalmic screening. Improved understanding of the changing incidence and risk factors can help improve the screening algorithms to identify high-risk babies for more targeted screening. More ophthalmologists must be trained to screen for ROP and eye screening must be integrated with all NICUs. Currently, there may be <200 ophthalmologists in India that have received specialized training in the screening and management of ROP.[11] Appropriate planning of evidence-based services can help Kerala address the potential epidemic of ROP.

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Conflicts of interest

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Original Article

Falling prey to superglue ocular injuries: A case series

ABSTRACT

Aim: Cyanoacrylate synthetic glue is an instant acting adhesive material often used for household, biomedical and industrial requirements. Accidental instillation of glue into eyes seems to be the commonest mode of chemical eye injuries especially in the paediatric and geriatric population. **Methods:** A series of five cases of synthetic glue eye injuries following accidental instillation into eyes that presented to our hospital were reported. **Results:** All the cases were managed conservatively as per the current guidelines with good visual outcome. **Conclusion:** These case series highlight how even daily activities utilizing the superglue may result in unexpected serious eye injuries. Creating awareness and provision of immediate medical aid can prevent ocular morbidity in such eye injuries.

Keywords: Cyanoacrylate glue, ocular injury, synthetic glue

INTRODUCTION

Cyanoacrylate glue is an instant acting adhesive material used most often for household, biomedical, and industrial requirements. It is colorless liquid in form with mild pungent odor and packaged in a small plastic container that resembles the packaging of eye drops or ointments. Chemically it is a derivative of Ethyl cyanoacrylate (ECA) and available in market as Superglue, Feviquick, or Powerglue.[1]

Due to its widespread usage, the incidence of accidental, inadvertent cyanoacrylate instillation into eyes occurs as a result of mistakes by patients, carelessness of children playing with the glue, and also as a result of splash accident. On literature review, the first documented case of ocular superglue injury was reported in 1982. Tabatebaei and colleagues reported 105 cases of ocular synthetic glue injury.[2]

This case series reports five cases of ocular injury caused by accidental instillation of cyanoacrylate glue and summarizes the appropriate management based on relevant literature review.

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CASE REPORTS

Case 1

A 5-year-old boy was brought to Emergency department with complaints of discomfort and inability to open right eye (RE) following accidental splashing of uncapped synthetic glue into his RE while taking it out from a cupboard. On examination, there was adhesion of lid margins along with matting of eyelashes [Figure 1a]. Specks of dried synthetic glue were seen on the right cheek and above the right forehead and eyebrow. The eyelids and eyelashes were separated by trimming of the eyelashes under topical 0.5% proparacaine anesthesia. The right eye was irrigated judiciously with Ringer Lactate for 30 min. This helped the child open his eyes completely [Figure 1b]. The slit-lamp examination revealed glue fragments on upper tarsal conjunctiva and cornea. The adherent glue fragments were removed under slit lamp. Fluorescein dye (2%) staining of cornea revealed diffuse

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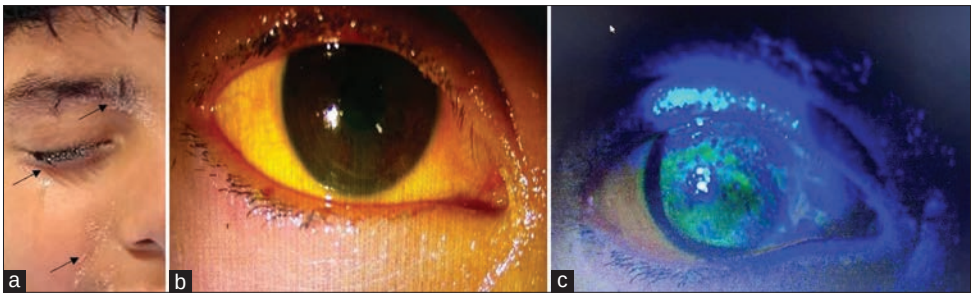


Figure 1: (a) Prior to removal of glue (Matting of eye lashes), (b) Eyelids opened after eye lash trimming, (c) Diffuse staining of cornea

staining pattern due to rubbing of glue fragments under matted lids [Figure 1c]. The RE was patched with antibiotic and cycloplegic drops for 24 h. The conjunctival and corneal abrasions healed completely within 48 h. Upon follow-up after 3 weeks, eyelids and trimmed eyelashes were found to be anatomically and functionally normal.

Case 2

A 4-year-old boy was brought to the Emergency department with history of accidental instillation of synthetic glue in right eye while doing a school papercraft assignment. On examination, lashes of both the eyelids of RE were found to be matted together and the child could not open the RE completely. Eyelashes were trimmed with lash cutting scissors smeared with antibiotic ointment to prevent trimmed lashes falling into the eye. Slit lamp examination revealed corneal epithelial defect from 6 o'clock to 11 o'clock. Eye was patched with antibiotic and cycloplegic drops for 24 h. On follow-up after 48 h and subsequently after 3 weeks, the trimmed eyelashes had grown to normal size in the right eye.

Case 3

A 74-year-old female reported with history of Feviquick injury to left eye (LE) when she mistook its tube for chloramphenicol eye ointment advised to her for treatment of meibomian gland dysfunction. There was a sudden gush of glue, which entered her eye. She complained of redness, pain in her LE, difficulty in opening the eye, and watering. There was swelling of upper eye lid, conjunctiva was congested, and cornea had the glue adherent to it obscuring the visual axis [Figure 2a]. The LE was irrigated with normal saline 5% for 30 min to wash out the glue. Thereafter, on fluorescein staining, there was a central 2 x 1 mm epithelial defect [Figure 2b]. She was prescribed antibiotic and cycloplegic eye drops, which healed the epithelial defect in 24 h.

Two cases more, one was a 60-year-old male who reported with similar injury with corneal epithelial defect while mending his broken spectacles [Figure 3] and another was a 12-year-old child who sustained this injury while fixing a flower vase [Figure 4]. Both these cases were also managed as previously stated and showed complete recovery.

DISCUSSION

Cyanoacrylate synthetic glue is available from 1958. It has very high tensile strength that rapidly polymerizes on contact with basic substances such as water or blood to form a strong bond. Because it is synthetic and nonbiodegradable, contact with delicate ocular surface induces an inflammatory foreign body reaction including neovascularization and tissue necrosis.[3]

Upon review of literature, the causes of ocular injuries were attributed to misidentification by patients who were prescribed topical eye medications, carelessness, and childhood curiosity. The result is accidental splashing of glue into the eyes while playing with the glue containers and deliberate forcible squirting of glue into eyes during assault. One hundred five cases of superglue injuries of the eyes have been published in the literature in the past 35 years. The most common clinical presentation was sticking of eyelids/eyelashes and inability to open the eyes. The most common signs were tarsorrhaphy-like appearance of the eyelids and conjunctival and corneal abrasion. The management included irrigation of the eye, trimming of eyelashes to remove the glue attached to the lid margins, and removal of the glue with forceps from the conjunctiva and cornea. The corneal abrasion was treated with topical antibiotics, mydriatics/cycloplegics, and eye patching. In some cases, conservative management was given, i.e., antibiotic eye drops and allowing the glue to fall off itself over a period of few days [Table 1].

No serious ocular morbidities were reported due to superglue injury in these studies. The age of patients varied from 3 months to 64 years and 25% of them were children. In our case series, the age ranges from 4 to 74 years and all had corneal epithelial defect. Accidental injury was reported to be the common modality.

Although some studies reveal that superglue tends to

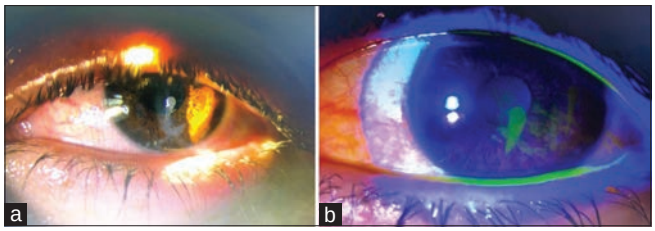


Figure 2: (a) Glue obscuring the visual axis, (b) Corneal epithelial defect post removal of glue

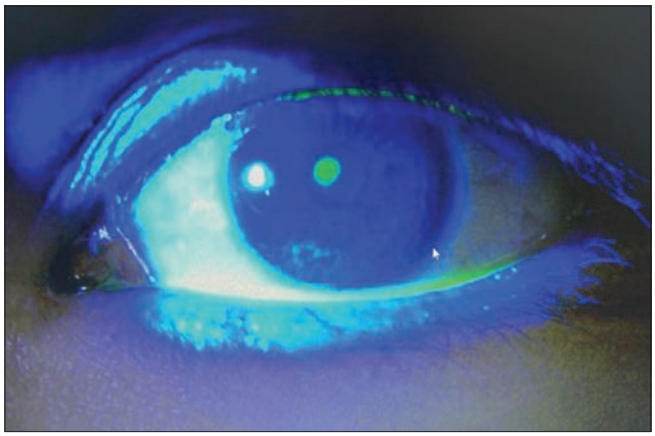


Figure 3: Corneal epithelial defect post removal of glue under topical anesthesia

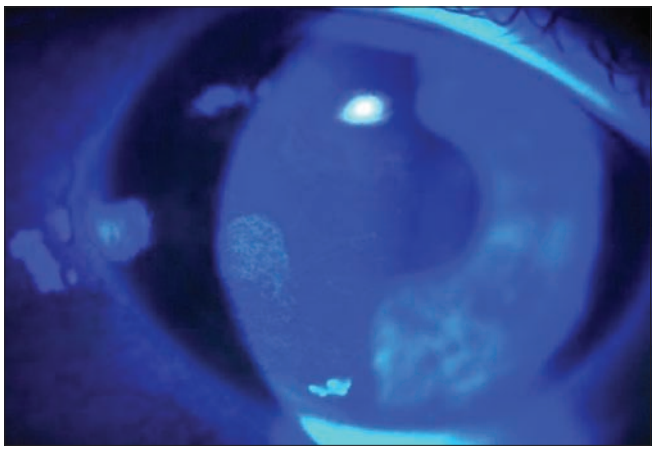


Figure 4: Epithelial defect ranging from 6 o' clock to 8 o' clock

bond on the dry surfaces, the actual polymerization/solidification reaction occurs in the presence of hydroxy ions derived from water.[2] Because some studies in the literature established that cyanoacrylate works well in moist conditions, it explains why on instillation the glue bonds with ocular surfaces resulting in sticking of eyelashes or eyelid margins (ankyloblepheron), which is very common in superglue injuries. The patient blinks forcibly as a reflex reaction due to stinging or burning pain in the eye because of its chemical nature and the glue is forcibly pushed onto the lid margin and eyelashes, thereafter solidifies. The glue causes chemical conjunctivitis and keratitis when it comes in contact with conjunctiva or cornea.

There are two main principles in the management of ocular superglue injuries.

(1) To reverse the chemically induced tarsorrhaphy so that comprehensive and detailed ocular examination can be performed and visible superglue can be removed.
(2) To identify the ocular damage by fluorescein staining and treat the ocular damage as per the standard protocols. Immediate irrigation of the eyes helps in removing some of the glue and reducing the rate of condensation of the glue and thus preventing ocular damage.

The cyanoacrylate glue can be removed by using acetone,[9] which is a solvent for the glue; however, in the eye, acetone may cause chemical injury to the conjunctiva and cornea. Removal of the glue on the lid margins can be tried by frequent cleaning with acetone swab. This is essential as continuous contact may result in periocular dermatitis. Simple application of antibiotic eye ointment over the glue also helps in teasing out the glue from matted lids.

Use of 3% sodium bicarbonate solution compress may prove to be more conducive in children who are not cooperative for mechanical or surgical release of eyelids.

Application of margarine,[10] high molecular weight oil, over the lid margins and eyelashes can be tried to dissolve the cyanoacrylate bonds on the lid margins. Superglues used domestically are lower alkyl derivatives than those designed for medical use and they have higher tissue toxicity.

Topical ciprofloxacin 0.3% is reported to cause crystalline punctate deposits and delayed healing of the cornea; hence, should be avoided. Instead, we used 0.5% chloramphenicol eye ointment, which is a broad-spectrum antibiotic to prevent the risk of any secondary bacterial infections.

The risk of ocular accidental application of superglues can be reduced by implementing changes in the package of their bottles, which include child proof cap to prevent conventional opening of the bottle, distinctive shape of the bottles, different odor to alert the user, and warning in bold print of light font against dark background on the bottles for better comprehension by geriatric population in view of their presbyopia and decreased contrast sensitivity. Suggestions written on the bottle should encompass keeping them away from easy access to children, and keeping them physically away from bathroom cabinets and dressing table

Table 1: Ocular findings and management of superglue ocular injuries published in the literature presented in Medline/PubMed

Authors	Year	No. of patients	Clinical Manifestations	Management
Margo *et al*.	1982	3	Eyelid sticking, kerato-conjunctivitis, corneal abrasion, corneal edema, and lid margin erosion	Topical antibiotics, lash trimming, and reversing tarsorrhaphy by irrigation
Morgan *et al*.	1984	1	Eyelid sticking	Cutting eyelashes, topical antibiotic, and eye patch
Silverman	1988	1	Corneal abrasion	Topical antibiotics and cycloplegics
Raynor	1988	1	Eyelid sticking	Separation with warm patch
Lyons	1990	6	Eyelid sticking, corneal and conjunctival epithelial abrasion, and punctate epithelial keratopathy	Glue removal and treatment with topical mydriatics and antibiotics
Good *et al*.	1994	2	Eyelid sticking and corneal abrasion	Antibiotic ointment, general anesthesia, and lid separation
Bruder *et al*.[4]	1995	3	Eyelid sticking and corneal abrasion	Overnight patch with ointment then lid separation with mechanical force, reverse tarsorrhaphy with acetone soaked cotton swap under general anesthesia, glue removal with forceps, and topical antibiotic drop
Landers *et al*.[5]	1997	1	Eyelid sticking and extensive corneal abrasion	Wet patch and surgical lid separation
Mc lean	1997	14	Eyelid sticking, corneal erosion, conjunctival erosion, conjunctivitis, and punctate epithelial keratopathy	Irrigation, lash trimming, and topical antibiotics
Rohrbach *et al*.	2000	1	Conjunctivitis and corneal abrasion	Intensive rinsing, mechanical removal, and topical antiinflammatory
Leibowits *et al*.	2000	1	Corneal and conjunctival erosion	Topical antibiotics
Knight	2001	1	Eyelid sticking and upper lid adhesion to cornea	Follow-up and conservative management
Needham *et al*.	2001	2	Eyelid sticking and corneal erosion	Mechanical lash removal and topical antibiotic
Terman.[6]	2002	1	Eyelid sticking	Admission for observation, pain management, 3% sodium bicarbonate solution compresses, moist compresses, and antibiotic ointments
Mandal *et al*.	2003	2	Eyelid sticking	Topical antibiotic and conservative management
Desai *et al*.	2005	3	Eyelid sticking and corneal abrasion	Conservative treatment
Wali *et al*.	2009	1	Eyelid sticking and corneal abrasion	Conservative treatment and topical antibiotic
Ogard *et al*.	2010	1	Eyelid closure	Surgical separation of the lid
Yusuf *et al*.	2010	1	Corneal abrasion	Topical antibiotics
Reddy	2012	3	Eyelid sticking	Separation of the lids by finger and trimming of eyelashes
Wong *et al*.	2012	1	Eyelid sticking	Tetracaine gel, cutting the lashes, dexamethasone/ neomycin/polymyxin B
Tabatabaei *et al*.[2]	2016	105	Corneal and conjunctival abrasion, eyelid sticking, hypersensitivity to glue	NA
Jijelava *et al*.[7]	2017	1	Eyelid sticking	Hook-assisted separation of eyelids and trimming residual glue
Zegers *et al*.	2017	1	Corneal abrasion and eyelid sticking	Mechanical removal of the glue and eyelashes
Pujari *et al*.	2018	2	Eyelid closure and erythema	Eyelash trimming
Cookey *et al*.	2019	1	Matting of the upper and lower lid margin and eyelashes, and corneal ulcer	Eyelash trimming, mechanical or chemical removal of glue, and corneal ulcer management with topical antibiotics, systemic analgesics, and vitamins
Steinemann *et al*.[8]	2018	1	Corneal endothelial insufficiency	Corneal endothelial keratoplasty
Akelma *et al*.	2019	NA	Causing thermal 2nd degree burns (in epidermis and dermis)	Irrigated under cold water

drawers will also lessen the risk of accidental instillation of superglue in the eyes.

CONCLUSION

Ocular superglue injury is a preventable cause of traumatic and chemical ophthalmic injury. Pediatric and the geriatric populations are the most vulnerable. Ocular morbidities range over a spectrum of mild to severe injuries, which may even require a surgical intervention. Strict supervision and protective norms should be followed to prevent future recurrences.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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Case Report

A case of cerebellar stroke/Wallenberg syndrome post-COVID-19 infection

ABSTRACT

Stroke has been reported as one of the several deadliest complications noted in COVID-19 infection. Stroke in COVID-19 is multifactorial and has propensity to involve large vessels and multiple territories. The most appealing mechanisms for strokes in COVID infection are the cytokine-induced coagulopathy and the endotheliopathy triggered by the infection. Stroke in young patients has been particularly observed. The treatment is also challenging in terms of judicious use of antithrombotic/anticoagulation agents concomitant to oral or intravenous steroids administration. We report a case of cerebellar stroke/ Wallenberg syndrome in a diagnosed COVID-19 patient with deranged coagulation profile and elevated interleukin-6. She presented with binocular diplopia, oscillopsia and had a very well documented skew deviation with torsional nystagmus. She also had impaired cerebellar functions. We also highlight the characteristic features of COVID stroke, its management, and shed light on the diagnosis of skew deviation and its management.

Keywords: Cerebellar stroke, COVID stroke, skew deviation

INTRODUCTION

There are multiple mechanisms implicated in the pathogenesis of stroke in COVID-19 infection. The diverse factors involved in stroke are hyper coagulable state, disseminated intravascular coagulation (DIC), cardiac dysfunction, vasculitis, cardiomyopathy, necrotizing encephalopathy. [1,2] The usual causes like hypertension, atherosclerosis and atrial fibrillation may also contribute. Since there are multiple mechanisms underlying stroke, the treatment is also a combination of anti-coagulation, anti-inflammatory and antiviral therapies. We report a case of stroke in a young female patient who had typical features of Wallenberg syndrome post COVID-19 infection.

CASE REPORT

A 40-year-old female with a history of cough, breathlessness, and recent diagnosis of COVID-19 infection presented to us with a history of loss of balance, inability to walk, swaying to the left side associated with giddiness, nausea, vomiting, and headache. She complained of binocular vertical diplopia associated with oscillopsia. She also gave a history of hematuria and menorrhagia. She was admitted to the COVID care center before presenting to us, and details of the medications administered were unavailable. Her hemogram showed low hemoglobin of 8.3 gm%. Platelets were adequate with normal morphology. Peripheral smear revealed microcytic hypochromic anemia with anisopoikilocytosis. Coagulation profile was found to be normal. C-reactive protein was mildly elevated at 15.7 mg/l (<10 being normal). Procalcitonin was in the normal range. Interleukin-6 (IL-6) was elevated at

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149.9 (normal being 0–50 pg/ml). D-dimer was deranged at 2630 (0–500 ng/ml is normal range). Lactate dehydrogenase was 569.2 (normal range of 140–280 U/L). She had a chest computed tomography (CT) score of CORAD 5. She was maintaining a saturation of 96% with 6 l of oxygen. Antinuclear antibodies were negative. Echocardiography showed left ventricular hypertrophy. CT scan of the brain was reported to have a nonhemorrhagic infarct in the left cerebellum [Figure 1a]. Magnetic resonance (MR) imaging of the brain and orbit areas, done a week later, featured gliotic area in the left cerebellar hemisphere and a tiny subcentimeter-sized area in the left dorsolateral medulla. MR angiography, in addition, showed constricted left vertebral artery with poor flow, suggesting a thrombo-occlusive disease process [Figure 1b].

On ocular examination, she had best-corrected visual acuity of 6/6 in both eyes. Intraocular pressure by applanation tonometer was 14 mmHg in both eyes. Fundus examination was done, and the images were captured on a fundus camera [Figure 2]. The patient had a left head tilt of around 10°. There was right hypertropia of around 18 prism Diopters which remained same in the right and left gazes and also with the head tilts, i.e., Parks' three-step test was inconclusive. In supine position, the hypertropia reduced significantly. There was no obvious under/overaction of any extraocular muscles [Figure 3]. The patient also had torsional nystagmus in both eyes [Video 1]. With the above findings, we came to a diagnosis of skew deviation secondary to a left-sided cerebellar infarct due to involvement of the left utriculosaccular pathways. Tests of cerebellar dysfunctions such as the finger nose nest, dysdiadochokinesia, and ataxia were positive on the left side. There were no signs of other cranial nerves involvement on either side. No focal neurological deficits were noted. The patient was treated with antiplatelet agents, intravenous methyl prednisolone, antihypertensives, antihistamines, iron, and multivitamin supplements. The patient was prescribed occlusion of one eye to alleviate the diplopia. Three months follow-up of the patient showed complete resolution of the skew deviation and the nystagmus. The patient had no complaints of diplopia, and there was even a marked improvement in her gait.

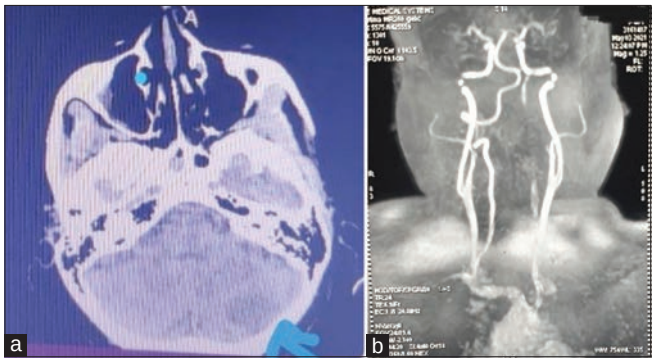


Figure 1: (a) Computed tomography scan brain plain showing a wedge-shaped hypodense area in the left cerebellar hemisphere likely suggestive of an ischemic infarct (blue arrowhead). (b) Magnetic resonance angiography demonstrating narrow caliber left vertebral artery with poor flow-related signal intensity involving cervical and intracranial segments

DISCUSSION

There are multiple mechanisms implicated in the pathogenesis of stroke in COVID-19 infection. The diverse factors involved in stroke are hypercoagulable state, disseminated intravascular coagulation, cardiac dysfunction, vasculitis, cardiomyopathy, and necrotizing encephalopathy.[1,2] The usual causes such as hypertension, atherosclerosis, and atrial fibrillation may also contribute. Since there are multiple mechanisms underlying stroke, the treatment is also a combination of anticoagulation, anti-inflammatory, and antiviral therapies.

World Stroke Organization reported that the risk of ischemic stroke during COVID-19 is around 5%.[3] COVID-19–related hemorrhagic strokes are far less common than ischemic strokes, but a few cases have been reported.[4-7] The median time from the first COVID-19 symptoms to the identification of stroke was 10 (5–16.5) days in one small single-center study.[8] Patients with COVID-19 who had strokes were more likely to be older and have hypertension with higher levels of D-dimer.[1]

Similarly, among 50 patients with ischemic stroke admitted in Wuhan, China, there was more comorbidity, with lower platelet and lymphocyte counts. These patients also had markedly higher levels of D-dimers, cardiac troponin I, NT pro-brain natriuretic peptide, and IL-6.[9]

Patients with COVID-19 fare worse in terms of clinical outcomes than patients with stroke who do not have COVID-19.[10,11] On

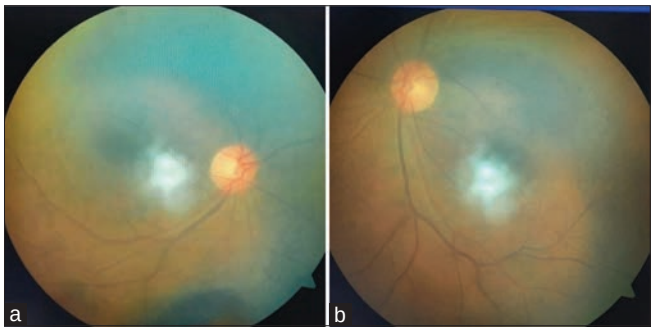


Figure 2: Fundus photographs showing (a) right eye intorsion and (b) severe extorsion in the left eye



Figure 3: Nine gaze image of the patient showing hypotropia of the left eye with no other extraocular muscle involvement

the contrary, our patient had complete resolution of diplopia, skew deviation, and nystagmus at 3 months of follow-up.

Our case report is a unique one with characteristic features of cerebellar stroke/Wallenberg syndrome, secondary to COVID-19 infection in a young individual with emphasis on complete recovery seen over a period of time. The patient demonstrated typical features of skew deviation observed in cerebellar strokes. She had classic triad of ocular tilt reaction, skew deviation and torsional nystagmus. Some of the points supporting the diagnosis of skew deviation in this patient are the presence of right hypertropia with inconclusive Parks' three-step test; no obvious under/overaction was seen on ocular motility evaluation. It is prophesied that always the eye on the affected side is lower. Hence, we had left-sided cerebellar infarct with hypotropia of the left eye, excyclotorsion of the left eye, and intorsion of the right eye. We also saw more than 50% reduction in hypertropia in the lying down position, known as positive supine test. The patient did not have any other features of Wallenberg syndrome, probably due to tiny size of the infarct.

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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Case Report

Peripheral ulcerative keratitis with multiple punctate scleral abscess – A rare presentation of ocular tuberculosis

ABSTRACT

This case report represents an unusual presentation of ocular tuberculosis (TB). Ocular TB is rare, but it can be the first clinical manifestation of the disease. Here, we report a case of a 67-year-old male, a chronic smoker who presented with pain, redness, and photophobia (BE), and slit-lamp examination showed multiple corneal infiltrate along the limbus with multiple scleral abscesses not responding to routine treatment. Investigations revealed high erythrocyte sedimentation rate value, positive Mantoux reaction, and changes on contrast-enhanced computed tomography of the thorax. Sputum CBNAAT was negative, and pus aspirate revealed no growth with negative staining for acid-fast bacillus. With high suspicion of TB, we started on Anti tuberculosis therapy, and there was rapid healing of lesions. In endemic areas, even when microbiological studies are not positive, ocular TB should be kept in mind in atypical cases so that early treatment can be instituted to prevent serious complications.

Keywords: ATT, ocular tuberculosis, peripheral ulcerative keratitis, scleral abscess

INTRODUCTION

India is the highest tuberculosis (TB) burden country in the world, having an estimated incidence of 26.9 lakh cases in 2019 (WHO). Pulmonary TB is responsible for 80% of the active systemic disease, the remaining 20% of the disease may affect other organs, including the eye.[1]

Ocular TB is rare, but it can be the first clinical manifestation of the disease.

Due to the rare occurrence of the disease, difficulty in detecting the bacillus, and the low suspicion index, diagnosis can be delayed leading to complications with high morbidity. Therefore, early diagnosis and treatment plays an important role.[2]

Here, we report a case of bilateral peripheral ulcerative keratitis (PUK) associated with multiple punctate scleral abscess with probable etiology of TB.

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CASE REPORT

A 67-year-old male, a chronic smoker with no comorbidities, presented to the outpatient department with pain, redness, and photophobia for duration of 5 days in the right eye and 3 days in the left eye. He had no history of trauma with any vegetative matter.

General and systemic examinations were within normal limits.

On examination, BCVA was 6/12 (OD) and 6/9(OS).

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Slit-lamp examination of the right eye showed lid edema with circumcorneal congestion, cornea showed multiple 2 mm × 1 mm epithelial defects with underlying infiltrate, well-circumscribed margins along the limbus from 4 to 7 o'clock position extending up to anterior stroma with surrounding stromal edema. AC showed cells 2+, flare 1+ [Figure 1]. The left eye also showed lid edema with circumcorneal congestion; cornea showed two 2 mm × 1 mm epithelial defects with underlying infiltrate, well-circumscribed margins at 7 and 8 o'clock position along the limbus extending up to anterior stroma with surrounding stromal edema. AC showed cells 1+, flare 1+ [Figure 2]. Indirect ophthalmoscopic examination of both eyes was normal.

Routine investigations revealed a high erythrocyte sedimentation rate of 116 mm/h; Mantoux was highly positive. Routine smear and culture of infiltrate were negative. Chest X-ray showed increased bronchovascular markings. Contrast-enhanced computed tomography of the thorax showed tree in bud appearance, which is a characteristic feature of TB [Figure 3]. However, sputum CBNAAT was negative.

Meanwhile, during the course in the hospital, the patient developed multiple punctate scleral abscess and the corneal lesions remain unchanged in both eyes.

The patient was treated with systemic and topical antibiotics; scleral abscess aspirate sent for routine culture showed no growth. Acid-fast bacillus (AFB) staining was negative for bacilli, and polymerase chain reaction (PCR) could not be done due to an insufficient sample.

A high index of suspicion along with supporting investigations led us to a provisional diagnosis of PUK with scleral abscess – probable etiology of TB.

The patient was started on ATT after pulmonology evaluation. There was a symptomatic and clinical improvement with rapid healing of lesions vindicating our stand [Figure 4].

DISCUSSION

TB is caused by *Mycobacterium tuberculosis*, one of the major causes of morbidity and mortality worldwide. Ocular TB is the infection by *M. tuberculosis* in the eye, around the eye, or its surface.

Ocular TB may not be usually associated with clinical evidence of pulmonary TB, as up to 60% of extrapulmonary TB patients do not have pulmonary TB.[3]

Incidence of ocular TB ranges from 1.4% to 5.74%; however, in an endemic region, it may reach up to 10%.[4]

Thirteen to fourteen thousand new cases are diagnosed per year, with 36% of these being diagnosed with extrapulmonary TB.[5]

Phlyctenulosis, conjunctival granulomas, and granulomatous anterior uveitis are the most common anterior segment presentations of ocular TB. The diagnosis of ocular TB can

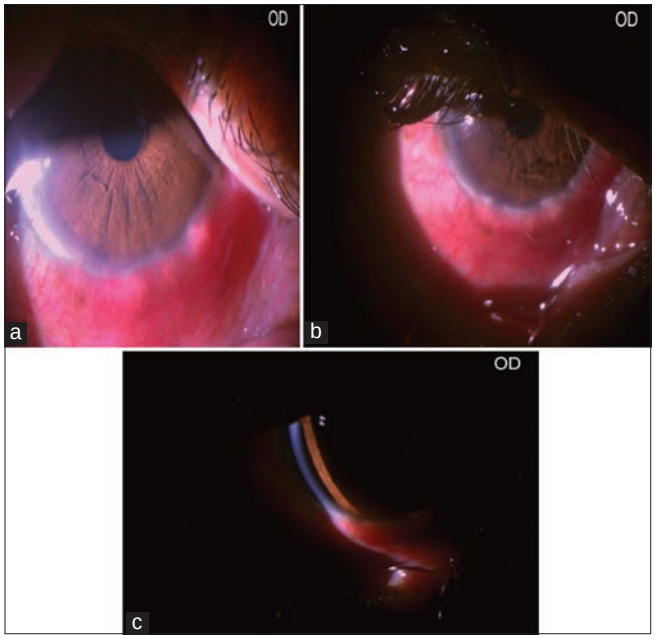


Figure 1: (a), (b), (c) Slit-lamp findings of the right eye showing multiple corneal infiltrate with punctate scleral abscess

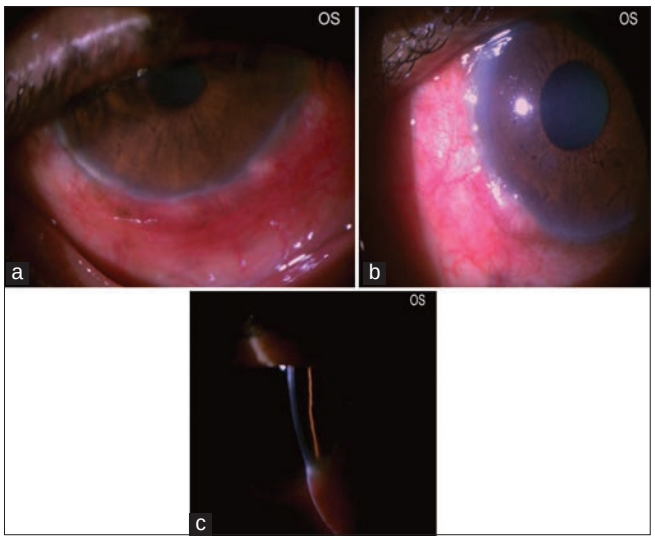


Figure 2: (a), (b), (c) Slit-lamp findings of the left eye showing corneal infiltrate with scleral abscess

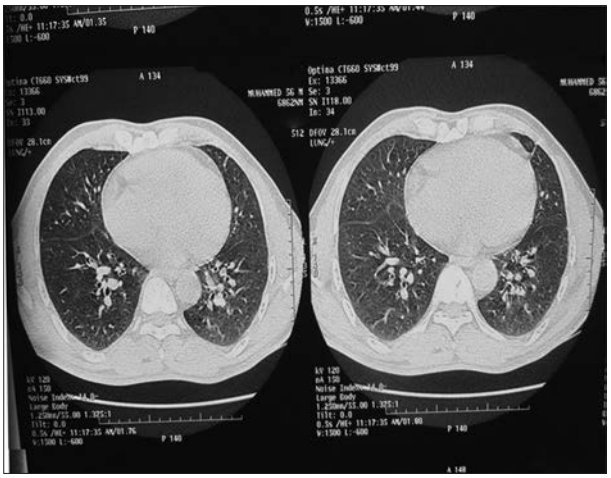


Figure 3: Contrast-enhanced computed tomography of the thorax showing a tree in bud appearance

be made either by isolation of the organism on LJ medium or histopathologic staining methods of affected tissues or detection of the organism by PCR.

In general, corneal involvement is rare in TB. Kamal *et al*.[6] described bilateral interstitial keratitis as a presenting manifestation of ocular TB in a 17-year-old girl which responded to topical steroid and ATT. Probable tubercular antigen in aqueous humor causing delayed hypersensitivity reaction was attributed to be the cause.

Arora *et al*.[7] reported bilateral disciform keratitis as presenting feature of extrapulmonary TB in an 11-year-old girl which on further investigation revealed tubercular Pott's spine.

In our patient, it presented as PUK with multiple punctate scleral abscess. PUK is a potentially devastating disorder with crescent-shaped destructive inflammation at the margin of the corneal stroma. Adjacent conjunctival, episcleral, and scleral inflammation are also generally apparent.[8]

Bayraktutar *et al*.[9] reported a case of ocular TB with progressive unilateral corneal melting with subconjunctival nodules in a 47-year-old female. The diagnosis was confirmed by the detection of bacillus DNA with PCR in the biopsy specimen of subconjunctival nodule; however, Ziehl–Neelsen staining of the specimen was negative for AFB. It was suggested that though histopathology is negative for AFB, the biopsy specimen should be examined by PCR. In our patient, PCR could not be done due to insufficient samples.

Gupta *et al*.[10] isolated *M. tuberculosis* on histopathological examination of a case with Sweet's syndrome who presented with PUK and scleral nodules.

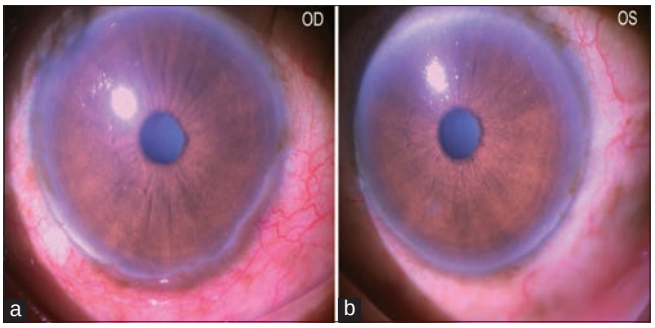


Figure 4: Findings showing healing of lesions. (a) right eye (b) left ey

Deepali *et al*.[11] reported a case of multiple disc-shaped corneal stromal infiltrates with hypopyon, which showed no improvement with empirical therapy and later with supporting investigations started on ATT and showed a rapid response. Similar to this case, our patient was unresponsive to routine treatment for PUK. Clinical suspicion of TB along with supporting investigations prompted us to start ATT, to which the patient responded well.

CONCLUSION

Ocular TB, though rare, should be kept in mind in the differential diagnosis of patients with such presentation not responding to the standard antimicrobial therapy, especially in endemic regions such as India, as early diagnosis and treatment can prevent serious 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.

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Conflicts of interest

There are no conflicts of interest.

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Case Report

Recurrent sphenoid wing meningioma extending into the orbit

ABSTRACT

Sphenoid wing meningiomas are slow-growing tumors that originate from outer arachnoid meningeal epithelial cells. They can present with progressive symptoms of an orbital or temporal fossa mass, including temporal fullness, proptosis, globe displacement, ptosis, and impaired ocular motility. The ophthalmic manifestations of sphenoid wing meningiomas vary depending on the location of the primary tumor. In this case report, we discuss a 52-year-old female with meningioma of unusual presentation which was reported to be removed completely, and recurrence was noticed after a lapse of 3 years with subsequent extension into the orbit resulting in the structural and functional destruction of the eye.

Keywords: Arachnoid, meningeal epithelial cells, meningioma, proptosis, sphenoid wing

INTRODUCTION

Meningiomas are typically benign slow-growing tumors that can be followed clinically and radiographically for recurrences. Sphenoid wing meningiomas are slow-growing tumors that originate from outer arachnoid meningeal epithelial cells.[1] The ophthalmic manifestations of sphenoid wing meningiomas vary depending on the location of the primary tumor.[2] The tumor can extend from the intracranial space into the orbit through bone, the superior orbital fissure, or the cavernous sinus. They can present with progressive symptoms of an orbital or temporal fossa mass, including temporal fullness, proptosis, globe displacement, ptosis, and impaired ocular motility. Tumors near the sella or optic nerve can cause visual field defects, optic disc edema, or atrophy. Eyelid edema and chemosis are also commonly encountered.[3] The average age of onset is 50 years with a higher incidence in women and Caucasians.[2] In this case report, we present a 52-year-old female with recurrent sphenoid meningioma extending into the orbit.

CASE REPORT

A 52-year-old female with a complaint of protrusion of the left eye (OS) for 3 years was referred to the ophthalmic outpatient department. History revealed proptosis, defective vision, and hearing on the left side initially in 2010. As per records, computerized tomogram and magnetic resonance imaging (MRI) confirmed left lateral sphenoid wing meningioma. Left pterional craniotomy with Simpson II excision of meningioma was done in June 2010 elsewhere. Histopathological findings showed WHO Grade I - Transitional meningioma. Postoperatively, the vision was 6/6 OS and the hearing was normal. After 3 years, she was again admitted for complaints of proptosis OS with restriction of eye movements. Vision OS was reduced to 6/60 Snellen. MRI showed a lesion in the extra- and intraconal compartments of the left orbit. She did not go for further follow-up. After a period of 2 years, she developed seizures with weakness of the right upper limb for which she was

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admitted and treated at a local hospital and later referred to our center. On examination, the right eye (OD) was normal; the left eyeball was atrophic which was pushed medially and downward by a large swelling that retracted the lids. The conjunctiva was stretched by the protruded swelling from the orbit and xerosed with irregular areas of crusting. The cornea was dry, opaque, and covered with crusts in the periphery [Figure 1a]. OS vision was no perception of light and MRI showed large soft tissue mass left orbit displacing the eyeball [Figure 2a and b]. She had associated difficulty in the left nostril due to thick mucoid discharge. OD was normal. Left frontotemporal craniotomy and excision of the tumor in the brain and modified exenteration left orbit were done and remaining flaps of upper and lower lids were used to cover the exenterated left orbit [Figure 1b]. Histopathological findings showed the meningothelial area with psammoma body [Figure 3a and b] which further confirmed the diagnosis. Postoperatively, she had seizures which were controlled medically and right hemiparesis improved slowly with physiotherapy. The patient had a follow-up after 3 months which was uneventful. She had been referred to the Department of Radiation Oncology for further management.

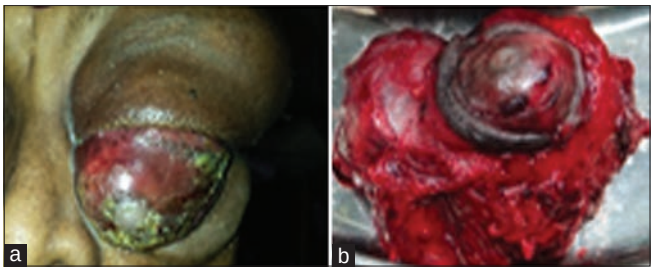


Figure 1: (a) Cornea with dry, opaque, and covered with crusts in the periphery and (b) excised tumor

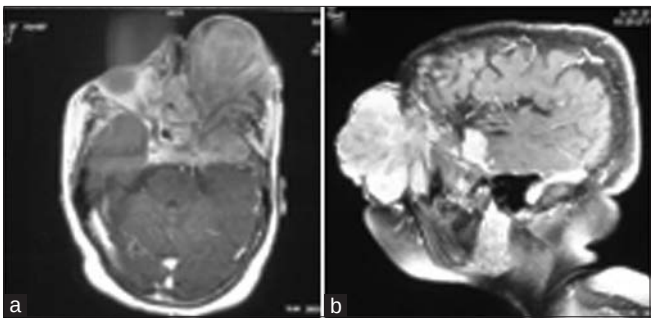


Figure 2: (a and b) Magnetic resonance imaging showing left lateral sphenoid wing meningioma

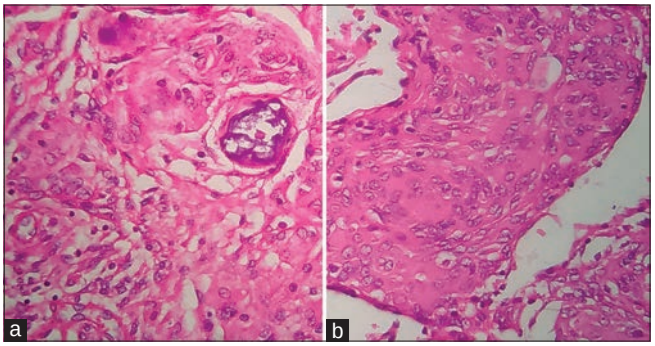


Figure 3: (a and b) Histopathology showing meningothelial area with psammoma body

DISCUSSION

Meningiomas represent approximately 4% of all intraorbital tumors[2] and can arise from the optic nerve or extend into the orbit from adjacent structures. Meningiomas are generally benign and are the most common intracranial lesions, accounting for approximately 18% of all intracranial neoplasms. The WHO grade I being the most common, associated with prolonged, recurrence-free survival, but a subset is clinically more aggressive.[4] Secondary orbital meningiomas usually arise from the inner and outer aspects of the sphenoid wing and infiltrate medially into the orbit. They often compress the optic nerve by narrowing the optic canal. They may infiltrate the contents of the supraorbital fissure and cavernous sinus or compress the frontal and temporal lobes.[5] In this case, there was widening of the left optic canal and bony orbit with hyperostosis of the left lateral orbital plate, greater wing of the left sphenoid, and medial aspect of the left temporal bone.

These secondary tumors invariably progress and may grow to overwhelming size with time[5] as evident in this case. Here, the meningioma had recurred after a lapse of 3 years and has extended into the temporal cranial fossa, maxillary and ethmoid sinuses. Meningioma may recur, either because of incomplete removal or a true recurrence. The overall recurrence rates range from 13% to 40%.[6] The patient in this case report had complete removal as per records and thus can be considered as true recurrence.

The most important factor in the recurrence of meningiomas is the extent of removal. Complete removal of a meningioma is not always feasible and remnants of the tumor may be left behind in the dura, involved bone, venous sinus wall, or parts of the tumor adherent to vital structures thus leading to recurrence.[7] Secondary intraorbital meningiomas arise intracranially and subsequently extend into the orbit. These tumors can present as secondary in additional sites such as clinoid, planum sphenoidale, frontoparietal area, and olfactory groove. Some secondary tumors are quite large and both orbits can be involved.[4] Thus, it appears that meningiomas with orbital involvement, progress, leading to potential

neurological compromise.[5] Our patient had developed seizures with weakness of the right upper limb.

A select group of lateral sphenoid wing meningiomas with tumor extension in the lateral or superolateral compartments of the orbital cavity may be successfully approached and removed through a lateral orbitotomy with resection of the sphenoid wing and without craniotomy. Cases with tumor extension to the anterior clinoid process and superior orbital fissure and those with extension medial to the axis of the optic nerve require a transcranial approach.[8] In this patient, both transcranial and orbital approaches were required. Radiation therapy has also been shown to be effective in controlling local tumor growth. Additional resection is another option. Complete resection is still the most desired result, as it may be curative. Current advances in peri and operative management, especially preoperative endovascular embolization, intraoperative computer-assisted image guidance, and refined surgical methods assist the surgeon in achieving optimum outcomes.

CONCLUSION

This case report concluded as the meningioma was initially removed completely and recurrence was noticed after a lapse of 3 years with subsequent extension into the orbit with structural and functional destruction of the eye. Hence, the interventions should be done as early as possible in order to avoid both structural and functional damages in case of recurrent meningioma. Successful treatment of such lesions requires the expertise of ophthalmic and neurologic surgeons as teamwork.

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Declaration of patient consent

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

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Conflicts of interest

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Case Report

Off-center presentation of ocular myasthenia

ABSTRACT

Myasthenia gravis is an autoimmune condition with varied presentations. In this, we report a 70 years old diabetic male who came complaining of diplopia. On examination, he had ptosis and restriction of extraocular movements on the right side with bilateral normal pupillary reflexes. We diagnosed him to have diabetic neuropathy initially, however his ptosis worsened, leading us to revise the diagnosis. Ice pack test was positive, repetitive nerve stimulation showed a decremental response, and serum acetylcholine receptor antibodies were positive, confirming the diagnosis of ocular myasthenia. We started the patient on oral pyridostigmine and steroids and his symptoms improved. This report emphasizes the need for a high degree of suspicion for the timely diagnosis of ocular myasthenia gravis.

Keywords: Decremental response, diplopia, myasthenia, ptosis, pyridostigmine

INTRODUCTION

Myasthenia gravis is an autoimmune disease where autoantibodies directed against the acetylcholine receptors will lead to abnormal functioning of the neuromuscular junction resulting in weakness of the skeletal muscles, which in turn results in varied clinical features. Ocular muscles are often involved at the earliest and can be the only affected group in certain situations as isolated ocular myasthenia.[1,2] The typical features of ocular myasthenia gravis include drooping of eyelids, ophthalmoplegia, and features of orbicularis muscle weakness. Medical professionals related to ophthalmology should have extensive knowledge about the nature of the disease and its prompt diagnosis with existing treatment options as in some circumstances it can be life-threatening as in myasthenic crisis. Many cases often require neurologist consultation and electrophysiological testing for the confirmation and initiation of treatment. This case report emphasizes clinical awareness about atypical presentation and prompt treatment about myasthenia.

CASE REPORT

A 70 years old male patient presented with complaints of drooping of the right eyelid for the past 4 days, which was preceded by a history of trivial trauma. The patient also had complaints of double vision for both distance and near objects, which disappeared on closing either eye. No history of any other neurological complaints, no headache and scalp pain, jaw claudication, and dysphagia. He is a known case of non-insulin-dependent diabetes mellitus for the past 15 years and is on regular oral medications.

Detailed ocular examination was carried out for the patient and Snellen's visual acuity of the patient was 6/6 in both eyes, both eyes' pupils were round and reacting briskly to light. Right eye 15° exotropia noted with ptosis [Figures 1 and 2]. Levator palpebrae superioris function of the right eye is 5 mm and left eye examination was normal. Dilated fundus examination of both eyes was normal. Relevant investigations have been carried out and found to have glycated hemoglobin of 8.2. A provisional diagnosis of right eye pupil sparing third nerve palsy secondary to microvascular abnormality (diabetes mellitus) has been made and diabetic medications have been revised with close follow-up. Three weeks after the initial presentation, the patient came with

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complaints of worsening of drooping of right eyelids and minimal drooping in the left eyelid. Ice pack test carried out was found to have an improvement in levator palpebrae superioris function of both eyes and fatigability noted in both eyes. We shifted our diagnosis from diabetic mononeuropathy to ocular myasthenia. To confirm the diagnosis, we performed myasthenia gravis including acetylcholine receptor antibodies (turned positive), and a repetitive nerve stimulation test showed a decremental response. We started the patient on oral pyridostigmine and minimal improvement was noted on a subsequent visit. Oral Prednisolone was started with Pyridostigmine. Patient was switched to mycophenolate mofetil under tapering steroid cover after 1 month. Ptosis and extraocular movements improved without any residual defects over a period of 2 months.

DISCUSSION

Myasthenia gravis is a disease of neuromuscular junction affecting skeletal muscles. This autoimmune disease is due to antibodies attaching to acetylcholine receptors and in severe disease causes destruction of receptors leading to a reduction in the number of acetylcholine receptors, which impairs the function of muscle action resulting in varying manifestations like ptosis, orbicularis muscle weakness, and restriction of extraocular movements. Myasthenia is characterized by bimodal age distribution and congenital myasthenia can also occur.[3,4] Thymus gland imaging is often required as the risk of thymoma is higher and thymectomy may be even beneficial.



Figure 1: Clinical photograph of the patient showing presence of ptosis in both eyes (right eye > left eye) with frontalis muscle overaction

About half of myasthenia gravis patients present with isolated ocular involvement. Most of them progress to have systemic involvement over a period.[5] The exact etiology for early involvement of extraocular muscles has not been defined and is probably due to increased response to minor changes in acetylcholine receptor activity. Most cases of ocular myasthenia will present with typical signs of drooping of eyelids which worsens as the day advances, and positive ice pack test, restriction of extraocular movements, presence of specific signs like Cogan's lid twitch, fatigability, see-saw sign, and pupil involvement usually is not seen.[6] In our report, an elderly patient had an atypical presentation in the form of sudden onset ptosis preceded by trivial trauma and diplopia with no history of any diurnal changes pointed towards ischemic third nerve palsy. Diagnosis of myasthenia was made with the help of investigation including antibody testing and repetitive nerve stimulation test. The patient was treated with oral pyridostigmine who eventually required oral steroids followed by mycophenolate mofetil.

Confirmation of myasthenia requires various investigations but most cases have a common presentation, and cases mimicking like ischemic third nerve palsy are rare, and prompt diagnosis is needed as management of the later is

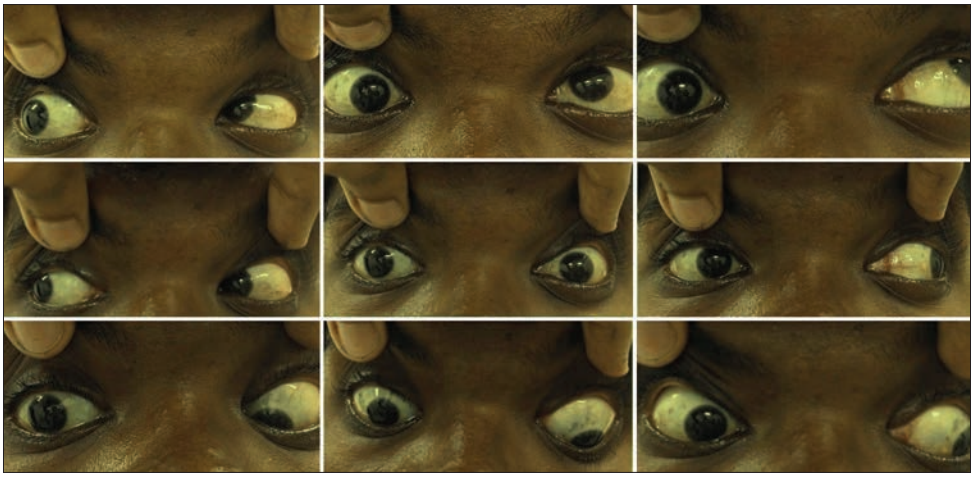


Figure 2: Clinical photograph of the patient showing restriction of extraocular movements in right eye similar to third nerve palsy (adduction is intact)

observation and undiagnosed myasthenia patient can have varied complications including respiratory failure in advanced cases and myasthenic crisis. The atypical presentation also requires specific enquiry about drugs that can precipitate myasthenia like fluoroquinolones.

CONCLUSION

Myasthenia should be suspected in any patient with ptosis and diplopia despite the absence of specific clinical findings. Prompt diagnosis often requires a high index of suspicion so complications can be avoided. The diagnosis requires clinical knowledge and investigations are often required to conclude.

Acknowledgements

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Consent

Written informed consent has been obtained from patient father for publication of the case details including the photographs taken.

Financial support and sponsorship

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Conflicts of interest

There are no conflicts of interest.

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Case Report

Vision "wipe-out" phenomena following a nonincisional laser procedure in the management of narrow-angle glaucoma

ABSTRACT

The "Wipe-out" or "Snuff-out" phenomenon refers to a permanent and severe loss of vision without an identifiable cause and is considered a rare but dreaded consequence of incisional ocular surgery. It is believed to occur in patients with advanced glaucoma who demonstrate a residual central island of vision. A 42-year-old female patient presented to the general ophthalmology clinic with complaints of painless blurring of vision of the left eye for 8 months. Best-corrected visual acuity (BCVA) was 20/30 and 20/40 and intraocular pressure (IOP) was 26 mmHg and 28 mmHg in the right and left eyes, respectively. Relative afferent pupillary defect was noted in the left eye. Anterior segment examination showed peripherally shallow anterior chamber and gonioscopy revealed appositionally closed angles (Shaffer-<20 Deg) in both eyes. Fundus examination showed advanced glaucomatous optic neuropathy of the left eye. Generalized depression in the right eye and inferior arcuate scotoma with a superior nasal step, and split fixation in the left eye was seen on Humphreys 30-2 visual fields. A diagnosis of chronic primary angle closure glaucoma was made and the patient was offered Nd: Yag Laser Peripheral Iridotomy (LPI). LPI was completed for the right eye and Argon Laser Iridoplasty was performed in the left eye as Iridotomy was not possible due to the proximity of the iris to the cornea as the pupil was mid-dilated. After the procedure, the patient was prescribed topical antiglaucoma medications with topical steroids at 1 week follow-up, the patient had BCVA of 20/30 in the right eye and hand motion in the left eye, IOPs were well controlled on topical anti-glaucoma medication. A thorough examination including a dilated fundus examination, B-Scan ultrasound, and fundus fluorescein angiography were unremarkable. Magnetic resonance imaging scan of the brain and orbits was normal. "Wipeout" phenomenon is a rare but notorious complication associated with incisional surgeries in patients with advanced glaucoma. It is also reported to occur following cataract and retinal incisional surgeries. There are no reports of a wipe-out after a commonly performed laser procedure.

Keywords: Glaucoma, laser, vision

INTRODUCTION

The "Wipe-out" phenomenon also known as the "Snuff-out" phenomenon refers to an unexplained permanent and severe loss of central vision and is considered a rare and dreaded consequence of incisional ocular surgery in patients with advanced glaucoma.[1,2] It is a complication believed to affect patients with advanced visual field loss and with only residual Central Island of vision.[3-5] This incidence is reported in between 1.9% and 7.7% with higher incidences reported in studies with relatively smaller sample sizes.[6-9]

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CASE REPORT

A 42-year-old female with uncontrolled epilepsy on oral carbamazepine presented to the general ophthalmology clinic of our center with the complaint of painless blurring of vision in her left eye since 6–8 months. Examination showed best-corrected visual acuity (BCVA) to be 20/30 and 20/40 and intraocular pressure (IOP) 26 mm of Hg and 28 mm of Hg in the right and left eye, respectively. Afferent pupillary defect (RAPD) was noted in the left eye. Anterior segment examination of the left eye showed shallow anterior chamber (Von Herrick's Grade 1) and appositionally closed angles on Gonioscopy (Shaffer-< 20 Deg). Fundus examination was remarkable for glaucomatous optic neuropathy of the right eye with a vertical cup to disc ratio of 0.7 with the presence of an inferotemporal notch and advanced glaucomatous optic neuropathy of the left eye with a vertical cup to disc ratio of 0.9–0.95 with diffuse neuro-retinal rim loss.

The case was referred to Glaucoma services. A 30-2 Humphrey visual field test was requested. Right eye visual fields showed generalized depression, and left eye showed an incomplete inferior arcuate scotoma extending into a superior nasal step and demonstrating split fixation on the numerical plot with absent pattern deviation plot because of severely depressed fields [Figures 1 and 2]. A diagnosis of chronic primary angle-closure glaucoma was made, and the patient was offered Nd: Yag laser peripheral iridotomy (LPI) for both eyes. LPI was performed in the right eye. However, due to the mid-dilated pupil in the left eye, LPI was not possible. Hence, Argon laser iridoplasty (LPI) was performed. Argon laser light was delivered using an Abraham iridotomy lens, with a spot size of 400 microns for 0.5s. The treatment was initiated at 300 mW pf power and increased till contraction of the iris tissue was seen. The beam was aimed as peripheral as possible onto the iris surface in the anterior chamber angle. Both the procedures were performed under antiglaucoma medications. Following the laser procedures, the patient was advised to start topical anti-glaucoma medications in the form of a beta-blocker and carbonic anhydrase inhibitor and a short course of topical steroids.

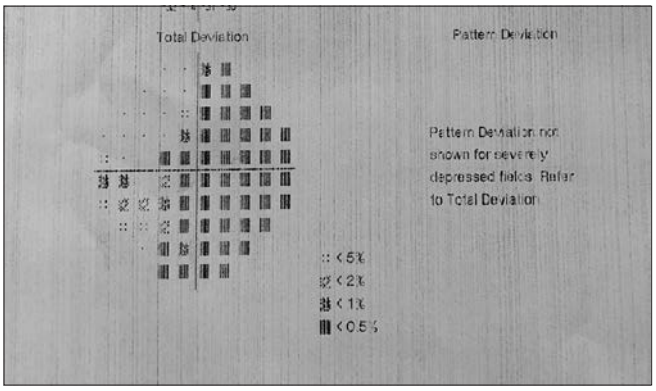


Figure 1: 30-2 visual field of the left eye showing incomplete inferior arcuate scotoma extending into superior nasal step, and absent Pattern Deviation plot because of severely depressed fields

The patient's BCVA after 1 week was 20/20 in the right eye and hand motion in the left eye, with well-controlled IOP on topical anti-glaucoma medications. A thorough ocular examination was done including dilated fundus examination [Figure 3], B-Scan ultrasound [Figure 4] and fundus fluorescein angiography [Figure 5], and optical coherence tomography was performed to identify the cause of sudden loss of vision. Anterior segment photography was done to demonstrate patent PI in the right eye and iris atrophic patches at the site of attempted LPI [Figure 6]. A magnetic resonance imaging scan of the brain and orbit was requested to rule out intracranial pathology. All the investigations were normal, ruling out contribution to the loss of vision.

DISCUSSION

Unexplained vision loss, known as "Wipe-out" or "Snuff-out" phenomenon is a rare but feared complication associated with incisional surgeries in patients with advanced glaucoma.[1-3] Theories have been suggested including disc hemorrhages occurring in association with surgical opening of the eye, perioperative cardiovascular insufficiency and nutritional instability, sudden hypotony induced by surgery, and as an unforeseen complication of retro-bulbar anesthesia.[3-5] A more recent small case series suggests an association between a significant loss of vision after glaucoma filtering surgery and progressive macular thinning observed on optical coherence tomography, advocating progressive retinal ganglion cell loss as a cause of vision loss after uncomplicated glaucoma surgery.[10]

Historical reports based on studies with a high variation in sample size show the incidence of unexplained central vision

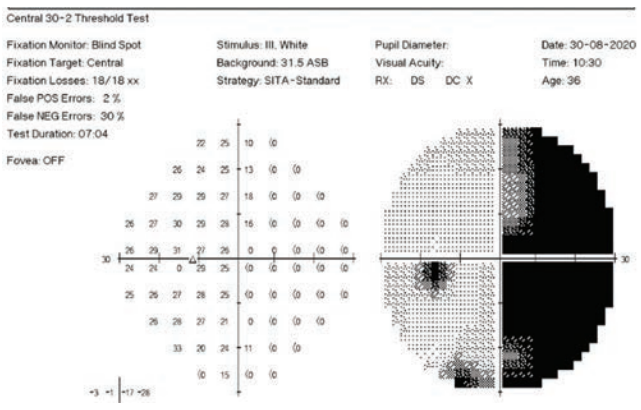


Figure 2: VF 30-2 demonstrating split fixation on the numerical plot

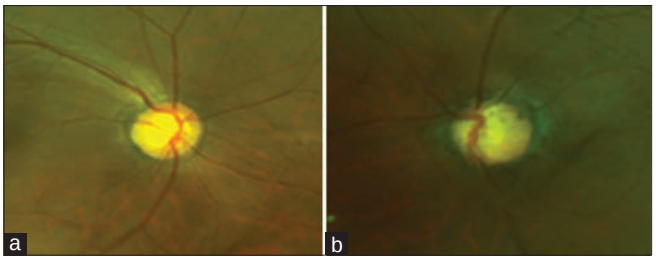


Figure 3: Color fundus photographs (a) Right eye shows early glaucomatous cupping. (b) Left eye shows advanced glaucomatous cupping with diffuse neuro-retinal rim loss

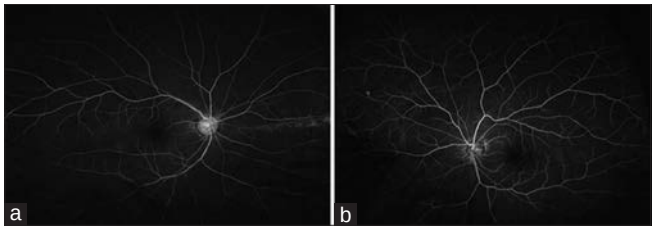


Figure 5: (a and b) Fundus fluorescein angiography of both eyes (late frame) showing normal arterial and venous blood flow

loss following trabeculectomy in patients with advanced glaucoma to range between 0% and 7%, underlying the concern many glaucoma specialists have regarding the unexplained vision loss following ocular surgery.[6-8] Recently, studies based on newer trabeculectomy techniques and standards show lower occurrence rates of the "Wipe-out" phenomenon ranging between 0% and 2%.[1,2] Yet routine counseling of patients with advanced glaucoma to the risk of unexplained central vision loss after different incisional ocular surgeries is widely practiced. The general consensus is despite the risk of the wipeout phenomenon as a complication, its occurrence is sufficiently rare that it should not supplant performing interventions when potential benefits outweigh risks.[4] This argument is particularly important when dealing with advanced glaucoma where inevitable vision loss and blindness may ensue if the disease progression is allowed to continue without necessary intervention.[11]

Studies have suggested the wipeout phenomenon to occur following trabeculectomy with and without antimetabolites and possibly cataract surgery as well. Risk factors found to be associated with the "Wipe-out" phenomenon include advanced age, preoperative split fixation on visual fields, as well as postoperative hypotony and choroidal effusions.[1]

Our patient who presented with chronic primary angle-closure Glaucoma of the left eye had advanced glaucomatous optic neuropathy with a cup to disc ratio of 0.9–0.95 and a visual field showing glaucomatous defects and split fixation on visual fields [Figures 1 and 2]. The first step in

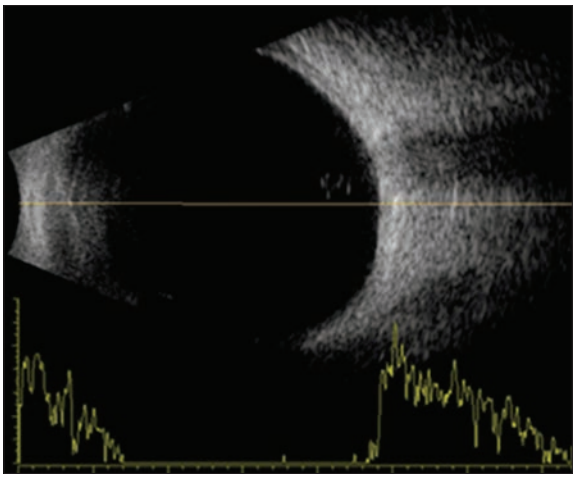


Figure 4: B-scan ultrasound of the left eye demonstrating normal posterior segment

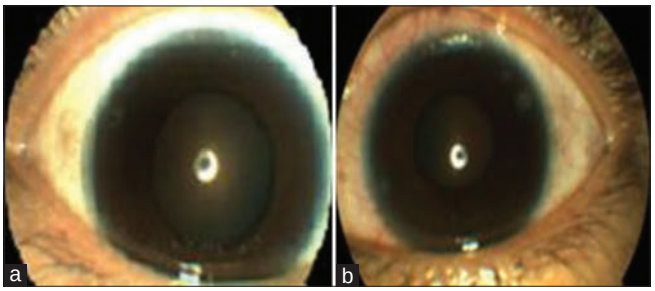


Figure 6: Anterior segment photographs 1 week after laser procedures. (a) Right eye shows a patent temporal laser peripheral iridotomy at 10 o' clock position, and a pharmacologically dilated pupil. (b) Left eye shows scarring of the Iris and atrophy around an attempted temporal laser peripheral iridotomy at 2 o' clock

her management following diagnosis was to address the appositional angle closure with Nd: Yag LPI to both eyes. Due to the inability to successfully perform, a LPI in the left eye argon laser Iridoplasty was performed. A week following nonincisional laser procedure which is commonly performed in the ambulatory care setting, the patient had developed unexplained loss of central vision and profound decline in visual acuity.

After utilizing reasonable and available investigations, we could only attribute this case of unexplained loss of central vision to the "Wipe-out" phenomenon. To the best of our knowledge, this presents the first case reported following an outpatient laser procedure. We wish to increase awareness and caution about this complication to ophthalmologists. We recommend adequate counseling of patients with advanced glaucoma who are undergoing routine outpatient procedures such as LPI or Argon laser iridoplasty of the potential risk of unexplained vision loss.

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.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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Case Report

Identifying the white forelock for early visual stimulation and speech therapy among X-men (van der Hoeve-Halbertsma-Waardenburg syndrome) in ophthalmology

ABSTRACT

A day-old male neonate presented with white forelock on his forehead. On evaluation, the neonate had telecanthus, broad nasal bridge, and surprisingly homochromic but hypochromic irides bilaterally. The W-index was 2.38 which was an indication of Type 1 Waardenburg syndrome (WS) with dilated fundus evaluation revealing pigmentary deficit in the retina depicting a orangish hue. The corneal diameter was 9 mm in both eyes. Both the external auditory meatus and external ears appeared normal. The parents who had a history of second-degree consanguineous marriage had visual acuity of 20/20 with normal dark brown irides and normal fundi. Genetic counseling, visual rehabilitation, and auditory evaluation to rule out sensory neural hearing loss were stressed upon for good quality of life, which is mandatory among neonates diagnosed with van der Hoeve-Halbertsma-Waardenburg syndrome.

Keywords: Van der Hoeve-Halbertsma-Waardenburg syndrome, White forelock, X-men

INTRODUCTION

van der Hoeve-Halbertsma-Waardenburg syndrome is a rare congenital disorder. It is seen in 1/42,000 of the population.[1] Almost all patients present with sensorineural hearing loss.[1] This syndrome is secondary to the absence of melanocytes in the skin, hair, eyes, and the stratified epithelium lining the upper part of the ligamentum spirale cochleae. It is a consequence of abnormal migration of cells derived from the neural crest.[2]

CASE REPORT

In this report, we report a day-old male neonate who presented with white forelock on his forehead. On evaluation, the neonate had telecanthus, broad nasal bridge, and surprisingly homochromic but hypochromic irides bilaterally [Figure 1]. The neonate had dystopia canthorum (i.e.,) lateral displacement of inner canthus which met the clinical criteria to diagnose this condition, which was calculated using the W-index as shown in Figure 2. The W-index was 2.38 in this child which indicated towards Type I Waardenburg syndrome (WS).[3] Dilated fundus evaluation revealed pigmentary deficit in both the retina with orangish hue [Figure 3]. The corneal diameter was nine millimetres in both eyes. Both the external auditory meatus and external ears appeared normal [Figure 4].

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Figure 1: (a) White forelock on the forehead, with telecanthus and broad nasal bridge. (b) Homochromic but hypochromic irides bilaterally

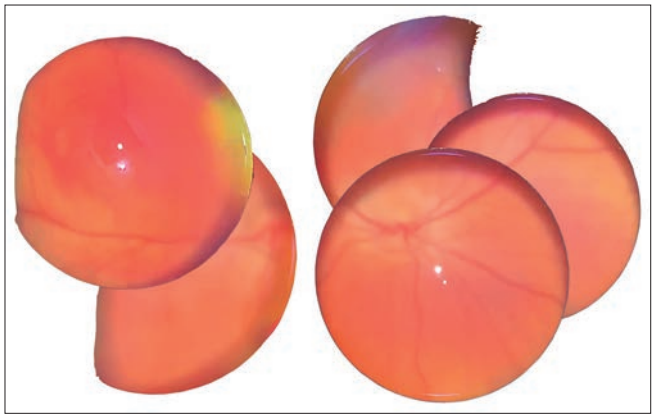


Figure 3: Smart phone fundus photograph done with indirect ophthalmoscope revealed pigmentary deficit in the retina with orangish hue in both eyes

The parents had history of second-degree consanguinity, with their first pregnancy dating 5 years back, culminating with a full term normal vaginal delivery, with the child expiring due to jaundice soon after birth during the neonatal period. Unfortunately, during the second pregnancy, the mother underwent spontaneous abortion in the 3rd month of

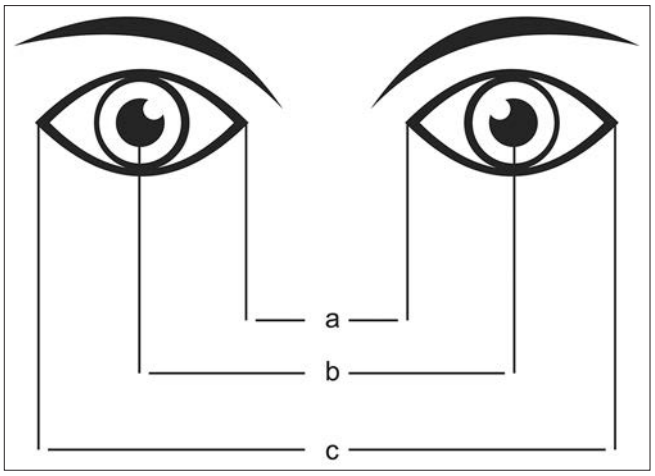


Figure 2: Diagnosis of dystopia canthorum by calculating W-index. W-index = X + Y + a/b; where X = (2a-0.2119c-3.909)/c; Y = (2a-0.22479b-3.909)/b; a: internal inter-canthal distance; b: inter-pupillary distance; c: external inter-canthal distance



Figure 4: (a and b) External ear examination showing normal anatomy

gestation. This brought to light the possibility that her fetus might have had congenital anomalies which were known to induce spontaneous abortions.[4] This pregnancy (third pregnancy) was uneventful with full term, normal vaginal delivery. General examination revealed normal extremities with no pigmentary changes on the body. Bowel habits were normal with no signs of constipation, ruling out Hirschsprung disease. Detailed pedigree charting was done but none of the family members had any such features according to their knowledge.

Both parents were examined and had visual acuity of 20/20 with normal dark brown irides and normal fundi. This further tilted in favor of an autosomal recessive inheritance pattern or *de novo* mutation. Genetic counseling was done and need for visual rehabilitation was explained. Auditory evaluation by means of brain evoked response audiometry to rule out sensory neural hearing loss which is mandatory for neonates,

so that speech therapy and hearing aids can be provided during the early period of life for good quality of life was carried out.

DISCUSSION

Types of Waardenburg syndrome

WS can be classified into four types. Type 1 and Type 2 can be clinically differentiated based on the major and minor criteria or by the presence or absence of dystopia canthorum. WS Type 2 does not have dystopia canthorum. For definition of WS Type 1, it needs to fulfil two major or one major and two minor criteria as listed below:

Major criteria

1. Dystopia canthorum: W-index needs to be >1.95; diagnosis of dystopia canthorum was arrived by calculating W-index; where W-index = X + Y + a/b ; where X = (2a − 0.2119c − 3.909)/c; Y = (2a − 0.22479b − 3.909)/b; a: internal inter-canthal distance; b: inter-pupillary distance; c: external inter-canthal distance
2. Pigmentation abnormalities: White forelock, depigmentation of eyebrows, eyelashes or body hair, and heterochromia of irides
3. Neurosensory cochlear deafness
4. Autosomal dominant family history.

Minor criteria

1. Cutaneous depigmented zones
2. Synophrys
3. Prominent nasal root
4. Hypoplastic alae nasi
5. Premature graying of hair.

WS Type 3 (Klein-WS) is a very rare subtype, characterized by associated musculoskeletal abnormalities such as muscle hypoplasia, flexion contractures, or syndactyly (fused digits). WS Type 4 is also known as Waardenburg-Shah syndrome which is a combination of WS, Hirschsprung disease and congenital aganglionic megacolon.[3]

Although multiple genetic mutations have been implicated in this syndrome, paired box gene 3 has been reported mostly in WS1 and WS3 patients. Microphthalmia associated transcription factor (MITF) gene is seen in WS2. Endothelin 3 (EDN 3), endothelin receptor type B (EDNRB) or SRY-sex determining region Y-Box 10 (SOX10) mutations have been reported in WS4.[5] However, we could not perform genetic analysis in this case due to logistic reasons, but it seems to be a *de novo* mutation because the patient has healthy parents and family members. Still, this patient was diagnosed with WS due to the fulfilment of two major criteria.

CONCLUSION

To conclude, diagnosing WS very early in the neonatal period alone is not enough, the need for genetic counseling, visual rehabilitation, and auditory evaluation for good quality of life should be stressed upon.

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 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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Photo Essay

Spectral domain optical coherence tomographic findings in Welder's maculopathy

ABSTRACT

This photo essay shows the spectral domain optical coherence tomographic (SD OCT) findings in Welder's maculopathy. A 34-year-old welder presented with metamorphopsia and a best-corrected visual acuity of 20/30 N8 in both eyes, respectively. Fundus examination showed absent foveal reflex and revealed orange-red spot surrounded by a pigmentary halo. The corresponding SD OCT showed a rectangular-shaped solitary hyporeflective space called the outer retinal hole. The hole extends from the inner layer of the retinal pigment epithelium to external limiting membrane, which in turn corresponds to inner segment/outer segment photo receptor junction (IS/OS). The straight edges of the hole and the top surface at the level of IS/OS junction line are lined by hyperreflective material. Central subfield thickness was 205 µm and 209 µm, respectively. SD OCT findings were similar to photic/solar maculopathy.

Keywords: Optical coherence tomographic characteristics, outer retinal hole, Welder's maculopathy

A 34-year-old welder presented with metamorphopsia and best-corrected visual acuity of 20/30 N8 in both eyes respectively. Fundus photo showed orange-red spot surrounded by a pigmentary halo [Figure 1]. Foveal reflex was absent. Spectral domain optical coherence tomography (SD OCT) of the macula showed a rectangular-shaped solitary hyporeflective space called the outer retinal hole (ORH). This extends from the inner layer of the retinal pigment epithelium (RPE) to external limiting membrane which corresponds to the inner segment/outer segment (IS/OS) junction. The straight edges of the hole and the top surface at the level of IS/OS junction are lined by a hyperreflective material [Figures 2 and 3]. Central subfield thickness measured was 205 µm and 209 µm, respectively. OCT characteristics were similar to that of photic/solar maculopathy.

DISCUSSION

Radiation emitted by welding arc ranges from infrared to ultraviolet spectrum and beyond. Retinal damage is believed to be caused by visible light and near infrared spectrum. Ultraviolet and infrared spectrum damage the anterior segment structures.[1] Welding arc can lead to subretinal neovascularization[2] or burns in the macula that can cause permanent loss of central vision.[1] Ultrastructural findings in solar retinopathy demonstrated changes in the photo receptor OS as vesiculation and fragmentation of photo receptor lamellae and whorls within the disc membranes.

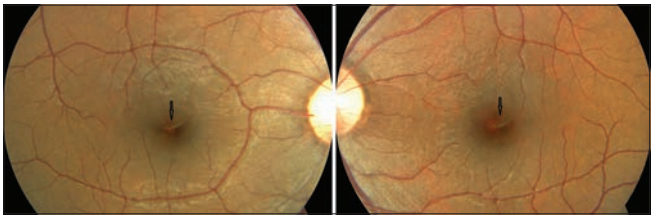


Figure 1: Fundus photo of the right and left eye showing orange-red spot surrounded by a pigmentary halo in Welder's maculopathy (black arrow)

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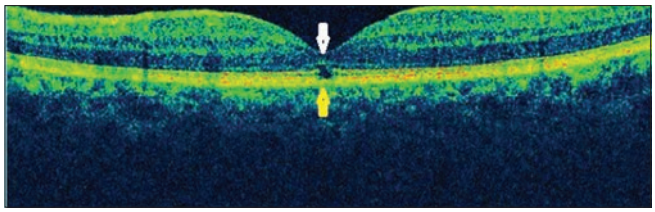


Figure 2: Optical coherence tomographic macula of the right eye showing outer retinal hole (yellow arrow) and hyperreflective lining with straight edges (white arrow)

Mitochondrial swelling and nuclear pyknosis were seen in the parafoveal rods.[3] Welder's maculopathy causes photochemical damage which damages the outer retina in contrast to thermal injury which damages the neurosensory retina. ORH is pathognomonic of Welder's maculopathy and is believed to be due to the accumulation of the damaged photoreceptor discs that could not be removed due to defective phagocytic function of RPE.[4] The hyperreflective lining of ORH could represent cellular debris.[5]

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.

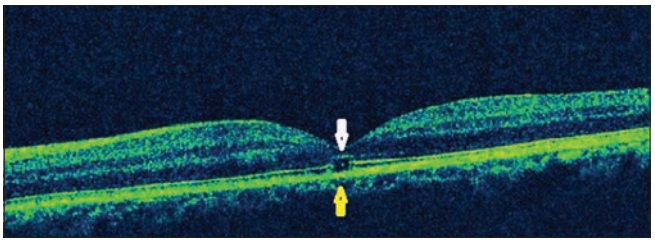


Figure 3: Optical coherence tomographic macula of the left eye showing outer retinal hole (yellow arrow) and hyperreflective lining with straight edges (white arrow)

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Conflicts of interest

There are no conflicts of interest.

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Photo Essay

Bilateral lens coloboma in child with Marfan's syndrome treated with lens surgery

ABSTRACT

Lens coloboma can occur with ocular or systemic associations like Marfan's and Stickler's syndrome. Causes of poor vision include refractive error, anisometropia and amblyopia. Visual rehabilitation and surgery is technically challenging in these patients. Here we report a child with progressive defective vision with Marfans syndrome and lens coloboma who underwent successful surgery with intraocular lens (IOL) placement. The bag was stabilised with capsule tension ring and iris hooks, and the IOL was further stabilised with optic capture. Postoperatively, the child regained good vision in the operated eye with very good centration of the IOL at three month follow up visit.

Keywords: Capsular tension ring, lens coloboma, Marfan's syndrome

INTRODUCTION

Lens coloboma in Marfan's syndrome is infrequently reported.[1,2] This is due to defective or absent development of the zonules and ciliary body.[3] Surgeryis technically challenging and successful, intraocular lens (IOL) placement depends on coloboma's extent and usage of capsular supportive devices like iris hooks, capsular tension ring (CTR), Cionnis ring or segments. We present the successful visual rehabilitation following IOL placement in the left eye of a child with the above condition.

CASE REPORT

A 13-year-old boy [Figure 1] with Marfans syndrome presented with progressively decreasing vision in his left eye of unknown duration. His best corrected visual acuity (BCVA) was 20/40 (−0.75/−3.5@180) and 20/125 (−8.0/−3.0@180) in his right eye (RE) and left eyes (LE), respectively. Slit lamp evaluation under mydriasis showed clear lens with coloboma extending from 12 to 2 o'clock (RE) and 9–1 o'clock (LE) [Figure 2] with few intact zonules. As left eye BCVA was low, we decided on surgery with IOL placement, after explaining possibility of subnormal visual outcome due to amblyopia.

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Figure 1: (a) Photograph showing a 13-year-old male with tall and thin stature. He had disproportionately long arms (b) with hyper extensibility of fingers

Following lens aspiration the capsular bag was stabilised with CTR (Aurolab, Madurai, India) [Figure 3], inserting

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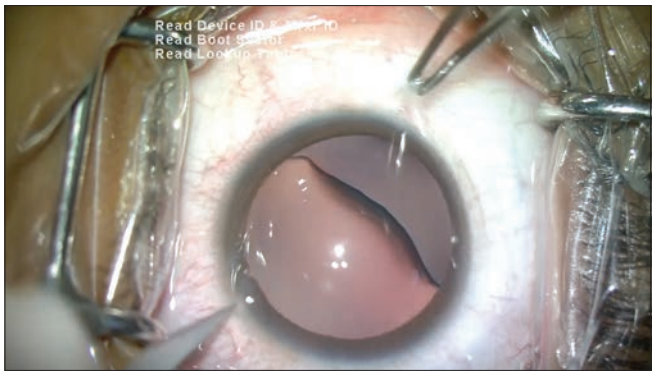


Figure 2: Picture showing lens coloboma in left eye from 9 to 1 o' clock position with intact zonules. The vision in his left eye was 20/125 (–8.0/–3.0@180)

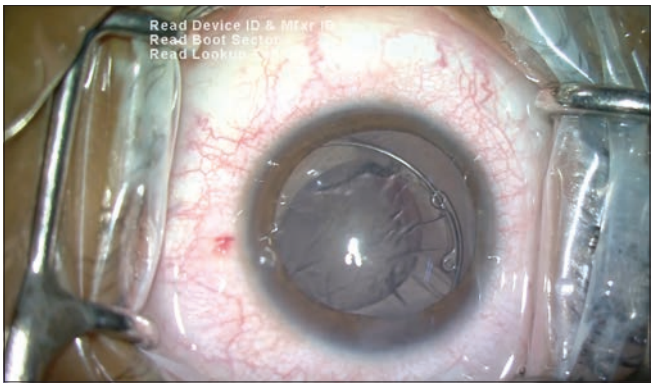


Figure 3: The capsular bag was stabilised with the capsular tension ring (Aurolab, Madurai, India), prior to aspiration of the lens cortex

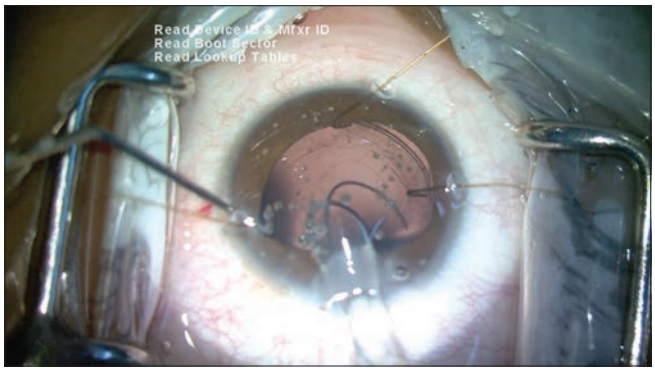


Figure 4: Three Iris hooks were used for dilatation and stabilisation of capsular bag prior to insertion of intraocular lens (Alcon Labs, Texas, USA)

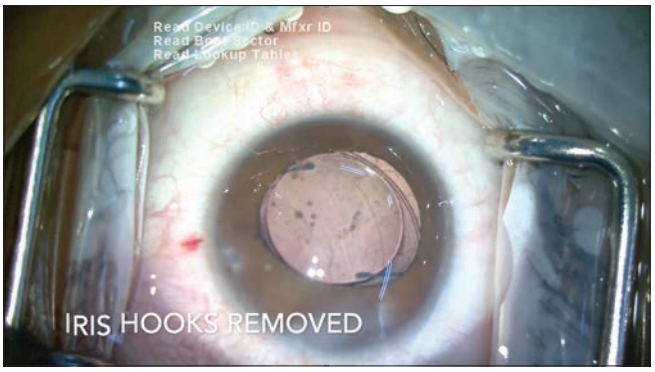


Figure 5: Picture showing a well centred Intra ocular lens with capsular tension ring in the bag. Best corrected vision has improved from 20/125 to 20/63 with negligible astigmatism postoperatively (–0.75DCyl@165)

which was technically challenging due to small and irregular colobomatous bag. Three iris hooks were used to stabilise the bag prior to three piece acrylic IOL (Alcon Labs, Texas, USA) implanted in sulcus with optic capture [Figures 4 and 5].

Postoperatively, visual acuity in his LE improved to 20/63 (−0.75DCyl@165) with well centered IOL.

DISCUSSION

Visual rehabilitation is technically challenging due to capsular fornix aspiration, zonular dialysis extension, vitreous herniation and IOL decentration.[3] Lens coloboma in Marfan's poses the difficulty of a small sized capsular bag with notching, in addition to the difficulties encountered in subluxated lens management. Also there exists a possibility of late decentation of IOL placed entirely in bag due to progressive myopia. Hence we decided on bag sulcus fixation of IOL, to aid in long term stability and centration.

The improvement in BCVA post surgery implies that the high myopia causing vision loss may have occurred beyond the amblyogenic years of his life.

IOL implantation can thus be an effective option to provide optimal visual rehabilitation in eyes with progressive vision loss in lens coloboma, in expert hands.

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 understand that 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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Statistical analysis of quantitative and qualitative variables—A quick glimpse

Karl Pearson, one of the founding fathers of statistics, once said—"Statistics is the grammar of science." Just like we need good grammar for effective communication, we also need proper statistics for advancing science.[1,2]

In previous issues, we dealt with types of variables and risk. In this issue, we will be dealing with the analysis of both quantitative and qualitative variables [Figures 1 and 2].

ANALYSIS OF QUANTITATIVE VARIABLES

Normality tests

The distribution of continuous quantitative variables should be checked. This can be performed with charts (histogram, Q-Q plots, or box plot) or with statistical tests (Kolmogrov–Smirnov or Shapiro–Wilk test). In normal distributions, we compare the mean using parametric tests. In non-normal distributions, the median is compared using parametric tests.[3]

Descriptive statistics

In descriptive statistics, we describe the baseline parameters of the study groups. We use mean and standard deviation to describe the data in normal distributions. For non-normal distributions, median and interquartile range are a better measure.

Analytic statistics[1-4]

Analytic tests can be carried out for finding:

1. Difference between two groups [Figure 1]
2. Correlation between variables.

Parametric tests

Difference between the means

1. Comparing two groups—T-tests
2. Comparing more than 2 groups—analysis of variance (ANOVA)

Both T-tests and ANOVA can be performed only if the data fulfills the following assumptions:

1. Data is quantitative
2. Variables are normally distributed.
3. Samples are random
4. Variance is equal in all samples[1,2,5]

T-test

There are 2 types of T-tests:

1. Unpaired T-test—two unrelated samples
2. Paired T-test—two related samples (before and after)

Unpaired T-test

This is sub-divided into one-sample T-test and two-sample T-test.

- The one-sample T-test compares the mean of a sample population to its standard value, for example, comparing for mean hemoglobin values of a group of diabetic patients to a standard value of 13.
- The two-sample T-test compares the means of two unrelated samples, for example, comparing central foveal thickness in two groups (bevacizumab group and ranibizumab group).

Paired T-test

This test is used when there are two related samples, for example, comparing the intraocular pressure before and after exercise.

2. ANOVA

ANOVA is used to detect the difference in means between three or more independent groups. There are three types of ANOVA:

1. One-way ANOVA: It can detect the difference in means between three or more groups, for example, comparing central foveal thickness measurement in three intravitreal injection groups—bevacizumab, ranibizumab, and aflibercept.
   However, the one-way ANOVA only shows if the means are different from each other. To know which pair is different, *post-hoc* tests such as Tukey or Scheffe tests are used.[1,4,6]
2. Two-way ANOVA: It compares two or more independent categorical groups that can be divided into sub-groups,

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for example, comparing central foveal thickness in three injection groups (bevacizumab, ranibizumab, and aflibercept) and also between males and females in these 3 groups. Here, we have two independent groups: type of injection and gender.

3. Repeated-measure ANOVA.

It is similar to the paired T-test. It is used to find the difference in means when more than two observations are made in the same subject, for example, comparing intraocular pressure before exercise, 1 hour after exercise, and 3 hours after exercise.

Correlation between variables

- **Correlation tests**

  Correlation tests are used to find relationships between variables and to quantify this relation. The correlation coefficient ranges from −1 to +1. If the correlation coefficient is zero, there is no correlation. If it is −1, there is perfect negative correlation, and if it is +1, there is perfect positive correlation.

  Cohen suggested the following interpretation of the absolute value of correlation:

  −0.3 to +0.3: Weak

  −0.5 to −0.3 or +0.3 to +0.5: Moderate

  −0.9 to −0.5 or +0.5 to +0.9: Strong

  −1.0 to −0.9 or +0.9 to +1.0: Very strong

  The most common test used for finding correlation is the Pearson correlation coefficient. In this test, both dependent and independent variables should be continuous and normally distributed.
- **Regression**

  Regression is the mathematical prediction of a dependent variable) using the value of an independent variable. There are different types of regression analytical models.
- Simple linear regression is used for continuous variables with one independent and one dependent variable.
- Multiple linear regression is used for continuous variables with multiple independent variables and a single dependent variable.

Non-parametric tests

If the continuous variable is not normally distributed, we should use non-parametric tests. These include:

1. Mann–Whitney test (Mann–Whitney–Wilcoxon or Wilcoxon rank-sum test or Wilcoxon–Mann–Whitney test): This test is the non-parametric equivalent test of unpaired T-test.
2. Wilcoxon signed rank test: This test is the non-parametric test equivalent of paired T-test.
3. Kruskal–Wallis test: This is the non-parametric equivalent of one-way ANOVA.
4. Friedman test: This test is the non-parametric equivalent of repeated-measure ANOVA.
5. Spearman correlation.
6. Logistic regression.

Analysis of qualitative variables

The tests used for categorical data are given in Table 1.

Table 1: Tests used for categorical data

Unpaired		Paired	
2 groups	>2 groups	2 sets	>2 sets
Chi square test Fisher's exact test	Chi square test	McNemar's Chi square test	Cochran's Q test

Pearson's chi square test

It is the most commonly used test for categorical variables. It determines the difference in the proportion between two or more independent categorical groups.

Fisher's exact test is an alternative to the chi square test. It is used for small sample sizes.

Chi square test for trend is used when one variable is binary and the other is ordinal. It is used to assess whether the association between variables follows a trend, for example, to know the trend of uveitis among the different age groups.

Chi square goodness-of-fit test

This test is applied to a single categorical variable drawn from a population through random sampling. It determines whether the sample data represents the actual population data.

Spearman correlation

Spearman correlation is the non-parametric equivalent of the Pearson correlation test. It determines whether two variables can predict each other. The test statistics varies from −1 (perfect negative correlation) to +1 (perfect positive correlation).

Logistic regression

This test is similar to linear regression. It is used to predict outcomes from one or more response variables. The variables may be categorical or continuous variables with skewed distribution.

Researchers must plan the statistical analysis at the beginning of the study itself. Choosing the statistical test is of paramount importance in a scientific paper. We hope that this article will

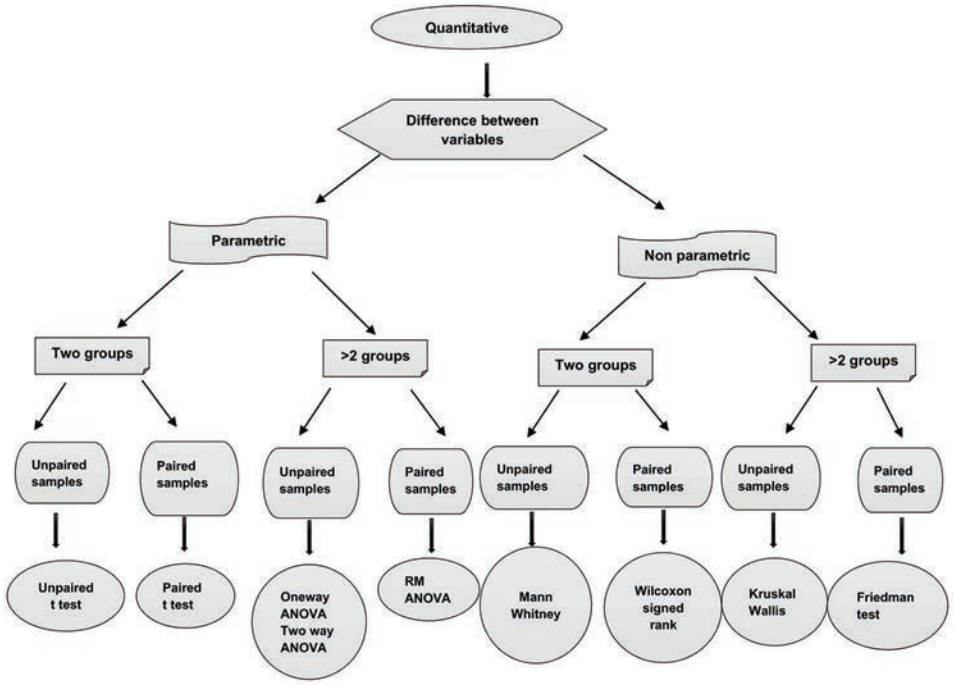


Figure 1: Analysis of difference between quantitative variables

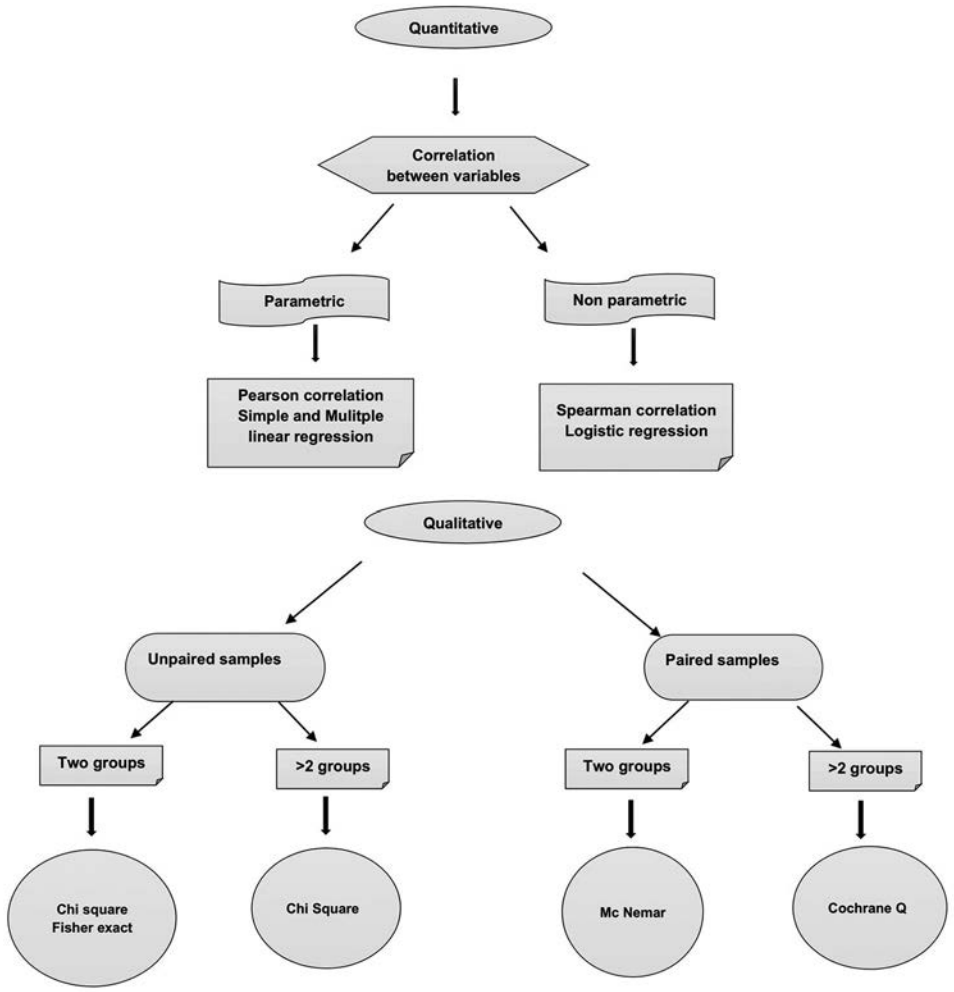


Figure 2: Analysis of correlation between quantitative variables and analysis of qualitataive variables

give an overview of the various analytical tests in statistics.

Figures below summarize the statistical tests.

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Conflicts of interest

There are no conflicts of interest.

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Effect of cataract surgery on wet age-related macular degeneration activity

Karesvuo P, Elbaz U, Achiron A, Hecht I, Kaarniranta K, Tuuminen R. Effect of cataract surgery on wet age-related macular degeneration activity. Acta Ophthalmol. 2022 Feb; 100(1):e262-e269. doi: 10.1111/aos. 14864. Epub 2021 Apr 10. PMID: 33838002.

Age-related macular degeneration (AMD) is the leading cause of irreversible legal blindness in people 65 years or older. With the continued aging of the world population, AMD is expected to grow in prevalence with the number of estimated cases expected to reach 288 million by 2040. The use of anti-vascular endothelial growth factor (anti-VEGF) therapies has revolutionized the care for patients with neovascular AMD.

There has been much debate and conflicting evidence as to whether cataract surgery causes progression of AMD. The timing of cataract surgery among wet AMD patients is a matter of debate. Cataract reduces retinal visibility and hinders treatment, in addition to reducing vision. At the same time, there is concern regarding the progression of AMD following cataract surgery. There is a lack of consensus regarding the protocol treatment of wet AMD patients undergoing cataract surgery. This study aimed to investigate whether cataract surgery in wet AMD patients affects its course and the relationship to how it influences the clinical outcomes.

The study was a registry-based retrospective cohort study of consecutive cataract surgeries performed on wet age-related macular degeneration (ARMD) patients at Helsinki University Hospital, Helsinki, Finland. The study included patients who underwent uncomplicated cataract surgery between January 2014 and December 2018. Data were collected from the operating room management system (BCB Medical, cataract database, Turku, Finland). For inclusion, all patients were required to have documentation on the type of postoperative medical treatment received, systemic medication, and anti-VEGF treatment for wet ARMD before laterality matched uncomplicated cataract surgery. The primary outcome of the study was to evaluate the change in central subfield macular thickness (CSMT) after surgery and at 1 year. Secondary outcomes were the changes in visual acuity, anti-VEGF treatment interval, macular status between the preoperative and postoperative phase, and the correlation between the CSMT change and the cumulative number of anti-VEGF injections before surgery.

The anti-VEGF treatment protocol used was the fixed-treat-and-extend protocol. Either bevacizumab 1.25 mg or aflibercept 2 mg was used as an anti-VEGF drug. Patients received three monthly anti-VEGF injections at baseline, and the treatment interval was lengthened accordingly: Three consecutive injections at a 6-week interval, two consecutive injections at an 8-week interval, one injection at a 10-week interval, and finally reaching the maximum 12-week interval. If the disease showed activation, the treatment intervals were shortened.

The cataract surgical technique used in this study was phacoemulsification with a 2.4–2.75 mm clear corneal incision. A single-piece acrylic monofocal intraocular lens (IOL) was implanted into the capsular bag. Postoperative medications were steroids, non-steroidal anti-inflammatory drugs (NSAIDs), or a combination of both. The duration of anti-inflammatory treatment was 3 weeks in almost all cases.

All patients underwent a comprehensive ophthalmic examination and optical coherence tomography (OCT) analysis. Foveal thickness, CSMT defined as mean thickness in the central 1000 μm diameter area and maximum thickness in the central 1000 μm diameter area were recorded by spectral-domain OCT (SD-OCT). Follow-up 30-frame SD-OCT scans were performed with AutoRescan™ software (spectral-domain OCT (SD-OCT, Heidelberg Eye Explorer Version 1.10.4.0 and HRA/SPECTRALIS R Viewing Module Version 6.13.3.0, Heidelberg Engineering GmbH, Heidelberg, Germany). The subtyping of wet AMD was done at the time of diagnosis with fluorescein angiography (FA) and/or indocyanine green angiography. Macular status on OCT scans of all cases was evaluated masked by a medical retina specialist.

Visual acuity was examined using a standard Snellen chart with the best-corrected refraction and using decimal numbers and converted to logarithms of the minimum angle of resolution (logMAR) for statistical purposes. Best-corrected visual acuity (BCVA) and OCT parameters were obtained at different time points, including at the time of wet AMD diagnosis, and within 18 weeks before and after surgery

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depending on the timing of out-patient clinic visits according to a fixed- Treat-and-Extend Regimen (TER) protocol and patients' treatment intervals, that is anti-VEGF injections may have been given in between the surgery and the latest OCT scans.

One hundred and eleven eyes of 111 patients with a mean age of 78.9 ± 5.6 were included in the study. Cataract surgery did not significantly influence the incidence of hemorrhages, pigment epithelial detachment, intraretinal fluid, or subretinal fluid when comparing macular status at the surgery to that at the first postoperative visit and 1 year.

At the time of cataract surgery, CSMT was 280.1 ± 75.0 μm, with a postoperative CSMT of 268.6 ± 67.6 μm (p = 0.001) and a 1-year CSMT of 265.9 ± 67.9 μm (p = 0.003). The BCVA in logMAR units was 0.70 ± 0.46 (Snellen equivalent median and interquartile range (IQR); 0.30, 0.125–0.40) prior to cataract surgery, and improved to 0.39 ± 0.40 (Snellen equivalent median and IQR; 0.50, 0.32–0.80) postoperatively ($p < 0.001$), and to 0.33 ± 0.34 (Snellen equivalent median and IQR; 0.50, 0.32–0.80) at 1 year ($p < 0.001$). After cataract surgery, foveal thickness increased >30% (from preoperative values) in only three out of the 111 eyes (2.7%). The CSMT change postoperatively inversely correlated with the CSMT level prior to surgery.

CSMT level before surgery significantly correlated with CSMT change postoperatively, whereas the cumulative number of anti-VEGF injections, anti-VEGF treatment interval, and presence of subretinal and intraretinal fluid at cataract surgery did not.

The effects of baseline factors like the existence of diabetes, systemic drugs like anticoagulants, calcium channel blockers, statins, and topical anti-inflammatory medications along with age and gender were examined for association with CSMT change postoperatively or at 1 year and the anti-VEGF treatment burden after surgery. None of these factors were associated with any clinical outcomes related to wet AMD first or 1-year postoperative visits, except for thinner CSMT at the first postoperative visit in those taking statins.

A relatively small cohort size (N = 111) and the short follow-up time are the primary limitations of this study. Another limitation of this study is that the time between pre- and postoperative out-patient visits and cataract surgery was not standardized because of the retrospective setting, which means that the macular edema may fluctuate depending on the cataract surgery and treatment intervals. On the other hand, the use of just a single standardized time point, such as a postoperative visit 4 weeks after surgery, would lack the information on macular status just before the next anti-VEGF administration. In Treat-and-Extend Regimen (TER) protocol, all out-patient visits were predetermined based on the disease activity and the current treatment interval.

The authors concluded that the timing of cataract surgery in wet AMD patients should be adjusted according to patients' needs. There is no justification to support delaying surgery until dry macula has been achieved. Surgery should, therefore, not be postponed for these considerations in patients who require it.

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Conflicts of interest
There are no conflicts of interest.

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Effects of Lipiflow treatment prior to cataract surgery: A prospective, randomized, controlled study

Park J, Yoo Y-S, Shin K, Han G, Arita R, Lim DH, *et al*. Effects of Lipiflow Treatment Prior to Cataract Surgery: A Prospective, Randomized, Controlled Study. Am J Ophthalmol 2021;230:264–75.

Majority of the patients complain of ocular discomfort after cataract surgery, despite an uneventful and successful surgery performed by a skilled expert. Regardless of the exact mechanism, Meibomian gland dysfunction (MGD), induced by cataract surgery has been shown to be responsible for postoperative ocular discomfort and dry eye, and requires adequate treatment. A number of studies have reported the efficacy and safety of Lipiflow treatment in treating MGD and have documented the potential benefit of Lipiflow as a primary treatment option for MGD and dry eye. It is not known whether or not prophylactic Lipiflow performed before cataract surgery can alleviate or prevent MGD and dry eye associated with surgery. The aim of this study was to investigate the effects of preoperative Lipiflow treatment before cataract surgery on alleviating obstructive MGD and dry eye induced by surgery.

It was a prospective randomized controlled study conducted at Samsung Medical Centre. This study comprised 124 eyes of 124 patients with planned surgery for senile cataract. Patients were enrolled in this study at the screening visit and randomized at a 1:1 ratio to either the Lipiflow group, whose members were treated with Lipiflow thermal pulsation or the control group, whose members were managed without Lipiflow treatment. In Lipiflow treatment, a topical anesthetic was applied before treatment, followed by bilateral application of a two-part activator. The inner portion of the activator, which covers the conjunctival surface of the upper and lower eyelids, heats to a temperature of approximately 42.5°C. The outer portion of the activator covers the cutaneous surface of the upper and lower lids and is inflated by air pressure. Both eyelids simultaneously receive warming and massaging for a period of 12 min. Patients with a history of ocular trauma or ocular surgery within 6 months, active infectious blepharitis or ocular infection, obvious abnormalities in eyelid margins or severe ocular surface abnormalities other than MGD, other cause of decreased visual acuity other than cataract, or those using systemic drug-like tetracycline derivatives, antihistamines, and isotretinoin were excluded from the study.

All patients underwent conventional phacoemulsification and posterior-chamber intraocular lens (IOL) implantation, conducted by two surgeons. The study design included four visits: one on three weeks before the planned cataract surgery, one on the day of cataract surgery, and one at each 1 and 3 months after surgery.

Tear film lipid layer thickness (LLT) measurement, meibography (partial or complete loss of meibomian gland (MG) was scored with LipiView II meibography), tear break-up time (TBUT), Oxford corneal staining score, and MG assessment with slit-lamp examination were done for each patient. After the ocular examinations, each patient was asked to complete the ocular surface disease index (OSDI) questionnaire and the five-item dry eye questionnaire (DEQ).

The gland orifices were evaluated under a slit-lamp microscope, using a handheld instrument, the Meibomian Gland Evaluator, which offers a standardized method of applying fixed pressure on each eye to ensure measurement consistency. The degree of gland expressibility was determined using pressure over the lower lids and was scored according to the number of fluid secretion-expressing glands among the eight at the centre part of the lower eyelid, regardless of qualitative appearance.

The primary endpoint with respect to the effect of Lipiflow treatment performed before cataract surgery was the changes in MG function from baseline to postoperative visits after cataract surgery. The secondary endpoint was the changes in ocular surface parameters and dry eye symptom in both groups. Also, the effects of Lipiflow treatment according to preoperative MGD status were investigated.

Meiboscores indicating structural loss of MGs were similar between the control and Lipiflow groups at baseline. The control group exhibited a significant decrease in MG expressibility, worsened meibum quality, decreased LLT, and worsened corneal staining after cataract surgery. Also, dry eye symptom showed significant worsening. Conversely, the

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Lipiflow group showed significantly improved MG patency and meibum quality, increased tear film break-up time, and reduced corneal staining; and presented improved subjective outcomes reported on both OSDI and DEQ. The improvement of each parameter in the Lipiflow group showed a linear correlation with baseline MGD grade. Patients with more severe MGD at baseline experienced greater improvement in expressibility and quality of meibum at 3 months postoperatively when treated preoperatively with Lipiflow, compared with those with milder MGD or those without MGD.

This study was the first report ever published to offer a prospective evaluation of the role of Lipiflow thermal pulsation therapy for the treatment and prevention of MGD-related dry eye after cataract surgery. Also, this study is an unbiased clinical trial with proper randomization, evaluating each and every parameter for a thorough understanding of preoperative Lipiflow treatment. This study has some limitations. Both morphological and functional assessment of MG, were conducted only in the lower eyelids. As Lipiflow directly acts on both the upper and lower eyelids, evaluation of both might yield more evident results. Although the patients were randomly distributed, baseline DEQ was different between the two groups. As such, rather than directly comparing the two groups, changes from baseline within each group were compared in this study. And also, the patients could not be masked whether they were included in the Lipiflow or control group, as Lipiflow devices do not offer Sham treatment mode.

The authors concluded that cataract surgery can produce or aggravate MGD and increase dry eye symptoms. Preoperative treatment with Lipiflow before surgery may ensure better outcomes by triggering improvements in ocular surface and MG parameters as well as subjective dry eye symptoms. Lipiflow treatment may be a safe and effective preoperative intervention for alleviating and preventing the MGD and dry eye associated with ocular surgery. It should be recommended before ocular surgeries, not only for patients with preoperative MGD, but also for those without baseline MGD, as it can prevent the development of MGD and dry eye induced by ocular surgeries.

As we used to have a lot of unhappy patients in spite of a good visual outcome after cataract surgery, use of Lipiflow for treating and preventing dry eye due to MGD, gives a new hope for cataract surgeons.

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Supranuclear and internuclear ophthalmoplegia - Gaze palsy

ABSTRACT

Gaze palsy is the loss of binocular control because of lesions of the pathways above the level of the nucleus.[1] To localize the lesion, an understanding of the supranuclear and internuclear pathways is necessary.

Keywords: Diplopia, gaze palsy, ophthalmoplegia

INTRODUCTION

Gaze is described as binocular, synchronous, and symmetrical eye movements in the same or opposite direction, such that the image of the object of interest falls on the fovea of each eye.

There are six systems of ocular movements, namely, the saccades, smooth pursuit, vestibular reflex, optokinetic, fixation, and vergences.

In this portion, we will discuss the horizontal and vertical saccadic eye movements [Table 1] and smooth pursuit movements [Table 2] along with some common lesions in the pathways.

Saccades are fast eye movements to fixate on an object of interest in the field of view when its image is not on the fovea. The impulse for saccades arises in the frontal eye fields.

Pursuits are slow tracking movements to maintain fixation on a moving object, and the impulse arises from the parieto-occipito-temporal cortex, cerebellum, and the superior colliculus.

Vestibular and tonic neck reflex eye movements maintain the alignment of the retinal image with respect to head position or neck position with the help of vestibular part of the ear and proprioceptors of the neck [Table 3].

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Horizontal gaze centre

The horizontal gaze centre, situated in the pons, is formed by the parapontine reticular formation (PPRF) and abducens nucleus. The sixth nerve nucleus contains two types of neurons. About 60% of the motor neurons project directly to the ipsilateral lateral rectus muscle as the abducens nerve, whereas the remaining 40% are interneurons that project via the medial longitudinal fasciculus (MLF) to the medial rectus subnucleus of the contralateral third nerve innervating the medial rectus of the opposite side. The PPRF and sixth nerve nucleus are situated very close to each other such that lesions here can only be differentiated by dissociation of saccadic and pursuit eye movements.

Horizontal gaze pathway

The pathway for horizontal gaze is slightly different for saccadic and pursuit eye movements as impulse to the nucleus arises from different parts of the brain. But both these have a common final pathway beyond the abducens nucleus.

The final common pathway from abducens nucleus consists of the following:

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1. Motor neurons to ipsilateral lateral rectus via abducens nerve that causes abduction of the ipsilateral eye.
2. Internuclear neurons via contralateral MLF to medial rectus subnucleus in third nerve nucleus of opposite side that causes adduction of the contralateral eye.[2]

Therefore, both the eyes move towards the side of stimulated abducens nucleus.

Table 1: Saccadic movements

Impulse initiation from the frontal eye field: Broadmann area 8 and relay centre superior colliculus
Crosses at the level of pons to contralateral PPRF
Impulses from PPRF transmitted to ipsilateralabducens nucleus
Final common pathway

Cortex of one side of the brain controls saccadic eye movements to the opposite side [Figure 1a].

Table 2: Smooth pursuit movements

Impulse initiation from higher centers such as parieto-occipito-temporal cortex, cerebellum, and superior colliculus
Fibers synapse directly to ipsilateralabducens nucleus without relay in PPRF
Final common pathway

Cortex of one side of the brain controls pursuit eye movements to same side. Pathway for pursuit eye movement does not relay in PPRF as pursuit eye movements do not need excitatory burst neurons in PPRF that is required to make high velocity saccades [Figure 1b].

Table 3: Vestibulo Ocular system

Impulse from vestibular system (inner ear labyrinths)
Fibers synapse in ipsilateral vestibular nuclei
Projects to contralateral abducens nucleus
Final common pathway

Stimulation of horizontal semicircular canal results in horizontal ocular rotations away from the side of the canal. This is the basis of vestibular nystagmus in labyrinthine dysfunction.

Horizontal gaze paresis

Features of horizontal gaze paresis depend on the location of the lesion. Lesions in the pons are the most common cause of horizontal gaze paresis. Common etiologies for any gaze paresis (horizontal and vertical) include the following:

- Infarction
- Hemorrhage
- Multiple sclerosis
- Tumor
- Central pontinemyelinolysis
- Wernicke's encephalopathy.

Progressive supranuclear palsy (vertical saccades are affected mainly, later all eye movements are affected as the disease progresses).

Lesion of the PPRF

Loss of all ipsilateral horizontal saccadic eye movements.

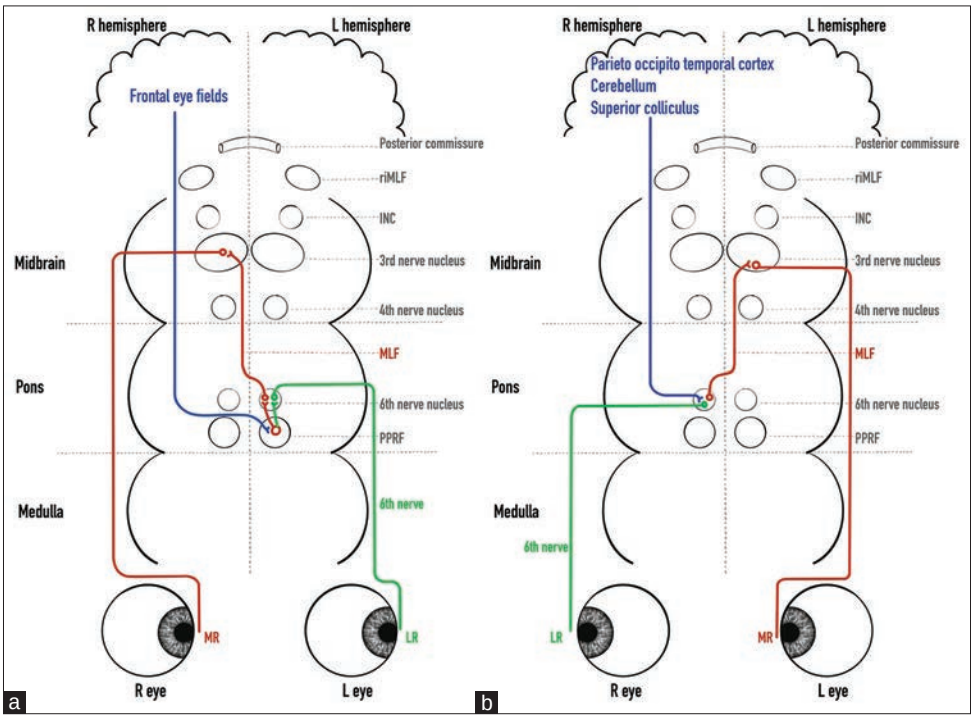


Figure 1: Horizontal gaze pathway (a) Saccadic movement - eye movements to one side controlled by contralateral hemisphere. (b) Smooth pursuit movement - eye movement to one side controlled by ipsilateral hemisphere

Vestibulo ocular reflex and pursuit eye movements are spared as their fibers innervate the abducens nucleus without relay in PPRF [Figure 2a].

Lesion of abducens nucleus/6th nerve nucleus

Loss of all ipsilateral voluntary (saccadic and pursuit) and reflex (vestibulo ocular) conjugate eye movements. Infarction of the anterior cerebellar artery can lead to lesion in the PPRF and/or the abducens nucleus [Figure 2a].

Internuclear ophthalmoplegia (INO)

INO occurs when lesion is in the MLF that connects the abducens nucleus to contralateral third nerve nucleus (hence, the term internuclear). It can be unilateral or bilateral INO.

Unilateral INO

- Ipsilateral adduction deficit
- Contralateral dissociated horizontal abduction nystagmus [Figure 2b].[3]

INO is considered to be only half gaze palsy. Localization of the lesion in MLF (rostral or caudal) can be made by checking for the involvement of convergence. Stimulus from the near reflex system synapses directly to the third nerve nucleus in the rostral midbrain region. Therefore, if

1. Convergence normal – caudal MLF lesion;
2. Convergence impaired – rostral midbrain lesion.

Usually, there is no strabismus in primary gaze, but in rostral lesion, patient may have exotropia in primary gaze called as wall-eyed monocular INO.

Bilateral INO

Bilateral adduction deficit with simultaneous abduction nystagmus;

- Convergence normal or impaired, based on the location of lesion;
- When there is exotropia of both eyes in primary gaze, it is called as wall-eyed bilateral INO [Figure 2b].

One and a half syndrome

- Lesion of PPRF or sixth nerve nucleus and MLF on same side
- Ipsilateral horizontal gaze palsy (one) and ipsilateral INO (half)
- Convergence will be spared as the lesion in MLF is essentially close to the PPRF [Figure 3a].

Eight and half syndrome

One and a half syndrome with facial nerve palsy because of ipsilateral involvement of facial fascicular nerve as it wraps around the abducens nucleus in dorsal pons.

Causes – vascular or demyelinating lesions in the dorsal tegmentum of caudal pons.

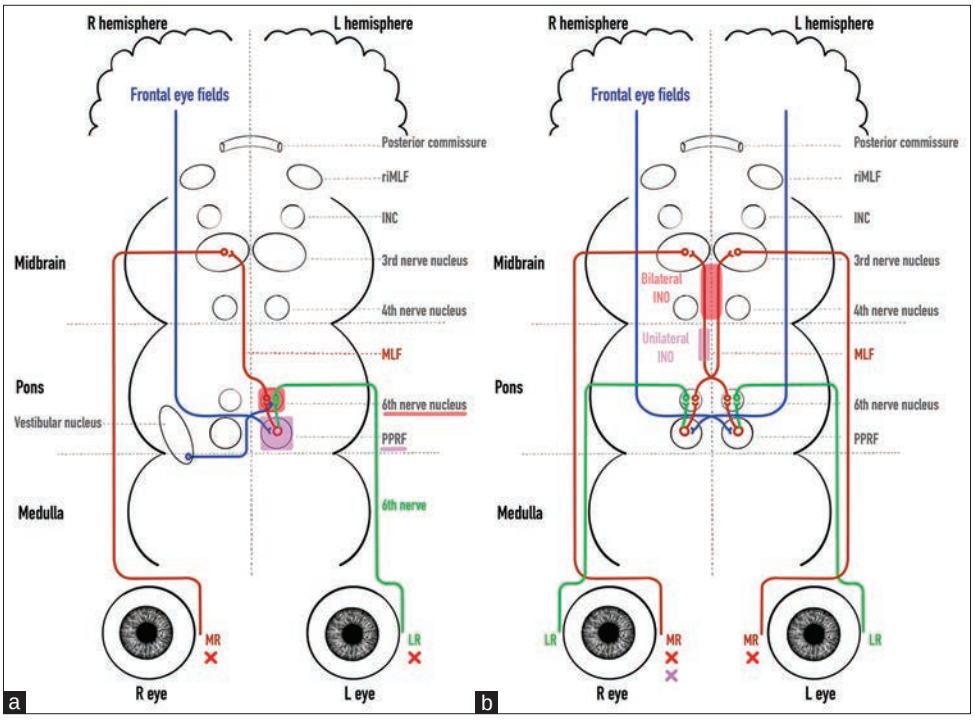


Figure 2: (a) Lesion of the PPRF or 6th nerve nucleus affects horizontal gaze to the ipsilateral side. Lesion of the abducens nucleus affects the vestibulo ocular system also. (b) Unilateral MLF lesion (purple) affects only ipsilateral adduction whereas bilateral MLF lesion (red) affects adduction bilaterally

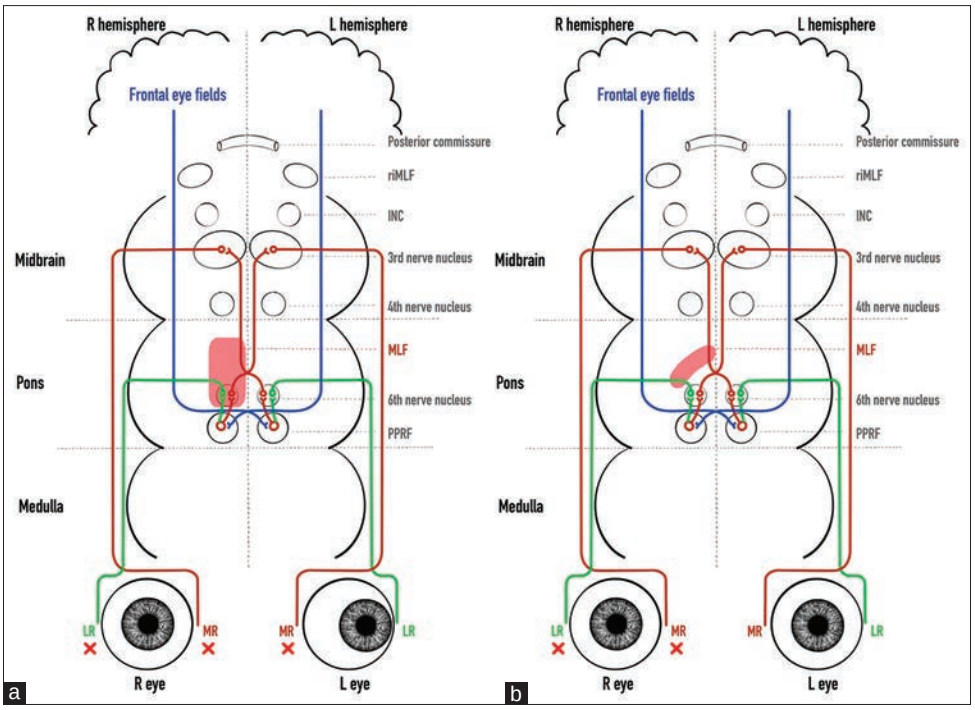


Figure 3: (a) Lesion seen in one and half syndrome. (b) Lesion seen in half and half syndrome

Half and half syndrome

Lesion of MLF of one side with ipsilateral sixth nerve fascicular involvement (not sixth nerve nucleus).

Therefore, HALF–HALF horizontal gaze palsy because of INO and other HALF because of sixth nerve palsy [Figure 3b].

Reverse INO/Lutz posterior INO/INO of abduction

Here, there is abduction restriction on attempted gaze to the same side with contralateral adduction nystagmus that is the reverse of INO.

- Reflex pathways are intact
- Described with ipsilateral rostral pontine or mesencephalic lesions
- Can be unilateral or bilateral.

Vertical gaze centre

The vertical gaze centre is situated in the midbrain (thalamomesencephalic junction), rostral to superior and inferior colliculus, and is formed by

- Rostral interstitial nucleus of the MLF (riMLF)
- Interstitial nucleus of Cajal
- Nucleus of posterior commissure
- Posterior commissure.

Vertical gaze pathway [Table 4]

Vertical gaze also has saccadic as well as pursuit movements with similar cortical control except the fact that initiation occurs in bilateral cortex for vertical gaze of the eye. The pathways from the higher centers project to the riMLF.[4]

Upgaze pathway [Figure 4a].

Upgaze paresis

Dorsal midbrain syndrome/Parinaud syndrome

- Lesions of the posterior commissure/nucleus of posterior commissure.
- Pineal region tumors are a common cause.

Other specific causes include infarction of paramedian/top of basilar artery infarction and obstructive hydrocephalus (Sylvian aqueduct syndrome).

Table 4: Initiation in frontal cortex, pretectum, and supplementary eye fields (bilateral event)
Signals reach riMLF of each side
riMLF sends signals to the following: 1. Contralateral riMLF 2. Ipsilateral INC 3. Ipsilateral and contralateral third nerve subnucleus of superior rectus (SR) and inferior oblique (IO) muscles
Fibers from the INC cross within the posterior commissure to reach the contralateral third nerve subnuclei

Table 5: Initiation in frontal cortex, pretectum, and supplementary eye fields (bilateral event)
Signals reach riMLF of each side
riMLF sends signals to the following: 1. Ipsilateral INC 2. Ipsilateral third nerve subnucleus of inferior rectus (IR) muscle 3. Ipsilateral fourth nerve nucleus (which supplies contralateral superior oblique SO muscle)
Fibers from the INC cross within the posterior commissure to reach the contralateral fourth nerve nuclei and third nerve subnuclei to IR

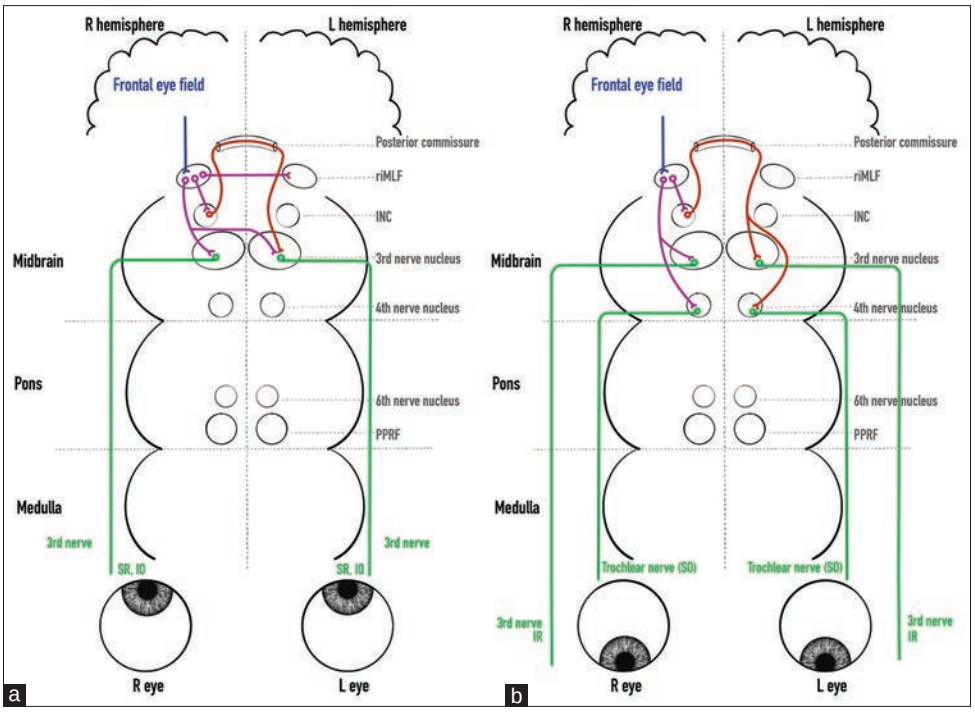


Figure 4: Vertical gaze pathway (a) Upgaze pathways.(b) Downgaze pathway

- Lid retraction (Collier's sign) – damage to inhibitory neurons to eyelid muscles,
- Light near dissociation (when pretectal involvement is present).
- Convergence retraction – nystagmoid movement with altered upgaze because of asynchronous convergent saccades.
- Skew deviation often with higher eye on the side of the lesion.

Downgaze pathway [Figure 4b and Table 5].

Downgaze paresis

Unilateral riMLF lesion

Downward saccade is more affected than upward saccade (as third nerve nuclei receive bilateral innervation from riMLF for upgaze, but not for downgaze).

Bilateral riMLF lesion

More common compared to unilateral riMLF lesion as it occurs because of infarction of paramedian arteries at the top of basilar artery (one medial artery supplies both riMLF). More severe than unilateral lesions.

Downward saccades are affected more than upward saccades, but a complete vertical gaze paralysis also occurs.

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Conflicts of interest

There are no conflicts of interest.

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Atypical presentation of multiple sclerosis – A few points to ponder

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The article by Dr. Aishwarya Angadi has brilliantly highlighted how multiple sclerosis can present as unilateral internuclear ophthalmoplegia. The author has meticulously examined the patient and presented it along with the detailed neurological findings. Early detection of multiple sclerosis can go a long way in reducing the morbidity of the disease through timely treatment and intervention.

From an academic point of view, there are a few points that I would like to contribute.

1. Since the patient complained of visual blurring, subclinical optic neuritis should have been ruled out with a visually evoked potential test.[1]
2. In the cerebrospinal fluid study, the number of oligoclonal bands is significant for the prognosis of multiple sclerosis.[2]
3. In a case of multiple sclerosis, NeuroMyelitis Optica Immunoglobulin G (NMOIgG) and anti-Myelin Oligodendrocyte Glycoprotein (anti-MOG) antibody should be tested.[3-5]
4. Lesions on Magnetic Resonance Imaging (MRI) should fulfil McDonald's criteria to qualify as those of multiple sclerosis.
5. MRI orbit is relevant in this case. Also, MRI brainstem should show lesions in the medial longitudinal fasciculus to explain the internuclear ophthalmoplegia.
6. As this patient was positive for Anti Neutrophil Cytoplasmic Antibodies (ANCA), autoimmune vasculitis should also be ruled out.

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Conflicts of interest
There are no conflicts of interest.

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