UP JOURNAL OF OPHTHALMOLOGY

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Cover Photo

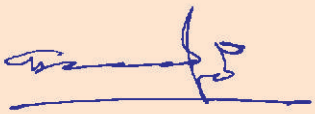
It is ICG IN A CASE OF PERIPHERAL HAEMORRHAGIC CHOROIDOPATHY, showing peripheral polyps on post operative ICG after vitreoretinal surgery for vitreous haemorrhage. Courtesy Dr. Shobhit Chawla, Prakash Netra Kendra, Lucknow.

Dear Dr Shalini Mohan,

It gives me great pleasure to know that UP State Ophthalmic Society is bringing out issue of the journal under your editorship.

The UP Journal of Ophthalmology has been a beacon of Ophthalmology research. It has long been one of the most influential journals in the field in this part of the nation. I am sure the UP Journal of Ophthalmology will maintain the highest level of ethical integrity, ensuring consistency and scientific rigor in each of its research articles. My desire is for the UP Journal of Ophthalmology to continue to excel and insightfully build for the future to provide the greatest venue for sharing outstanding science.

I am sure The UP Journal of Ophthalmology, under your editorship, will provide an insightful and stimulating science that will shape our future and lead the way to extraordinary discoveries.



Kamaljeet Singh, MS

President, UPSOS
Professor & Head, Department of Ophthalmology
MLN Medical College, Allahabad

"Post comes with pride, privilege and pleasure
But also carries patronage towards the assigned work."

Dear Members,

Hence, is this pen now contemplating the work from the editor's desk accepting the new responsibility bestowed upon me. I express my heartfelt gratitude to everyone.

There has been rampant upsurge in the flow of information through internet and social media in the last decade and now unfortunately we have reached at a stage where even the integrity and authenticity of the information is often questioned.The reader keeps surfing and scrolling through the galleries on internet under the wifi and then is found lost at the end of his search often raising more questions rather than finding the answers to his pre-existing queries.

So, there is still the felt need of genuine reading material, which is easy to access, carries practical information and is trustworthy to be readily implicated in the present day practice.

We shall put in the sweat of our spine to bring about such material for all the members and shall carry The UP Journal of Ophthalmology to newer heights. The current issue incorporates the articles from stalwarts of ophthalmology and shall definitely enlighten all the readers who will enjoy reading the publications. We would like to invite constructive criticism & feedback to improve the quality and content in the forthcoming issues. I am thankful to President, Secretary, Joint Editor, all executive members and respected members of editorial board for their support and guidance.

Wishing you all the best!

Warm regards

Dr Shalini Mohan

MBBS (Gold Medalist), MS, DNB, MNAMS
Editor, UP Journal of Ophthalmology
Associate Professor
Chief Glaucoma, Cornea Services & Eyebank
Department of Ophthalmology, GSVM Medical College, Kanpur (UP)
Vice President: KOS
Ex Senior Resident Dr.R.P. Centre, AIIMS, New Delhi
Ex Consultant, Sir Ganga Ram Hospital, New Delhi.

CONGRATULATIONS

Prof. Sandeeep Saxena, Lucknow.

for being conferred "AIOS INTERNATIONAL HERO AWARDS" at AIOC, Coimbatore, 2018

Dear Members,

Greetings!!

We started this new term with a very enthusiastic executive team members with the slogan "UPSOS for academics".Our main focus in the coming 3 years will be taking UPSOS and all its members to the helm of academics. The focus of all our conferences will be highest level of academics. And of course this journal will play a very vital role in this regard. And there could have been no better choice than our dynamic Editor Dr Shalini Mohan and our subeditor Dr Ram Yash Yadav to do this.

UP is the largest and most populous state of India. With several hidden gems in UP who do excellent work but do not publish. Our aim is to project those gems and share their vast knowledge and experience with the members and make our state the best in academics too. And we wish to see this UP journal of Ophthamology very soon as an indexed journal.

So happy reading and happy contributing!!

Dr. Mohita Sharma
General Secretary, UPSOS

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International UPSOS :

at New Zealand

28th April to 8th May 2019

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Contact : 8191084152

Midterm UPSOS :

at MRA Medical College, Ambedkar Nagar

25th to 26th May 2019

Organising Secretary : *Dr Amit Kumar Patel*

Contact : 9792175456

Femtosecond Laser Assisted Cataract Surgery: Are We There Yet?

Dr. Mahipal Sachdev
Chairman & Medical Director, Centre For Sight Group of Eye Hospitals
President, All India Ophthalmic Society

Femtosecond laser for cataract surgery has been commercially available since 2011, but has it revolutionised the way we perform cataract extraction? The near infrared laser causes photo disruption of tissue to produce exceedingly precise "cuts" with minimal collateral damage. A number of studies have validated the safety and efficacy of this relatively new technology. Day et al in a Cochrane review concluded "There is currently not enough evidence to determine the benefits and harms of laser-assisted cataract surgery compared with standard ultrasound cataract surgery. The evidence is uncertain because current studies have not been large enough to provide a reliable answerto this question." [1] However, Popovic and co-workers in a metanalysis of 14567 eyes, demonstrated that secondary endpoints including effective phacoemulsification time, circularity of the capsulotomy and endothelial cell loss were in significant favour of FLACS.[2] Sadly, as with the introduction of any new technique or technology, there has been a hesitation in adopting it over the more popular and universal traditional phacoemulsification. However, the indications of femtosecond for both simple and complex cataracts are evolving. The precision and predictability of the femtosecond laser allows its successful use in intumescent, hard, posterior polar and subluxated cataracts.[3-4] The use of arcuate keratotomies for corneal astigmatism management and anterior segment imaging to assess the posterior capsule in eyes with risk of dehiscence are additional advantages. As witnessed in the past, newer technologies undergo evolution and subsequent improvement. A reduction in the cost of initial equipment and patient interface would enable a wider acceptance and penetration of this technology. I strongly believe that the femtosecond technology is here to stay, and should eventually become the standard of care in cataract surgery.

References:

1) Popovic M, Campos-Mueller X, Schlenker MB, Ahmed II. Efficacy and safety of femtosecond laser–assisted cataract surgery compared with manual cataract surgery: A meta-analysis of 14,567 eyes. Ophthalmology 2016;123:2113–2126

2) Day AC, Gore DM, Bunce C, Evans JR. Laser-assisted cataract surgery versus standard ultrasound phacoemulsification cataract surgery. Cochrane Database Syst Rev 2016; 7:CD010735

3) Conrad-Hengerer, Hengerer FH, Joachim SC et al. Femtosecond laser-assisted cataract surgery in intumescent white cataracts. J Cataract Refract Surg 2014; 40:44-50.

4) Grewal DS, Basti S, Grewal SPS. Femtosecond laser–assisted cataract surgery in a subluxated traumatic cataract. J Cataract Refract Surg 2014; 40:1239–1240

UP STATE OPHTHALMOLOGICAL SOCIETY

C-53C, NTPC Township, C Block,Sector-33, Noida-201301

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Filling physical off line form and recommendation of 2 members is mandatory

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The above application is in order and can be put in front of the general body of ratification. Dated.....

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Panel Discussion on Multifocal IOL Practice

UPSOS Correspondent : **Dr Mohit Khattri**
Consultant, Regency Hospital Ltd, Kanpur

Expert Panel :

Dr Gaurav Luthra (GL)
Director, Drishti Eye Institute, Dehradun
Member Scientific Committee, AIOS

Dr Namrata Sharma (NS)
Professor, AIIMS, New Delhi
Hony General Secretary, AIOS

Dr Rupal Shah (RS)
Group Medical Director
Centre For Sight - New Vision Laser Centre,
Vadodara

Dr Sudhir Srivastava (SS)
Director, Sun Eye Hospital,
Lucknow

With the recent upsurge in the implantation of multifocal IOLs, we planned a panel discussion on the trends in multifocal practice across the country. We are sharing the excerpts from the discussion to help and guide the practitioners in day to day practice.

Q.1 Do you think multifocal IOL implantation has increased in present day world? If yes, then what's the foremost reason?

GL: Yes. Two reasons. Better IOL power prediction with optical biometry and newer formulas like Barrett's and Hill RBF leading to more patients in the + 0.5D range which is a key to happy patients with multifocals. Second reason is newer better IOL designs to customise to patient needs like the trifocals, quadrifocals and extended depth of focus. Better understanding of patient eligibility and exclusion is another important reason.

NS: Cataract surgery has gradually evolved into a refractive procedure, the goal being attainment of complete post-operative emmetropia. Since the multifocal IOLs provide spectacle independence for both distance as well as near, their use is on a rise. Cataract surgery has become refractive surgery now. Furthermore because of the changes in the lifestyle, the sugeon's and the patient's expectations are on the rise.

RS: Number is definitely on the rise.The reason is that cataract surgery is fast becoming refractive surgery and secondly there are lots of options available in terms of choice of IOLs

SS: Yes, there is definite increase in MF implantation nowadays, in my opinion better understanding with the technology is the foremost thing n obviously it is demand drive too.

Q.2 What are the two most important contraindications for multifocal IOL implantation in your practice?

GL: 1) Macular pathology 2) Patient with unrealistic expectations

NS: Patient selection is of utmost importance while planning cataract surgery with multifocal IOL implantation, in order to avoid postoperative dissatisfaction. Patient's personality plays an important in determining their ability to neuroadapt to the visual phenomenon seen following implantation of these IOLs. Patients with unrealistic expectations should better be planned for a monofocal IOL. The second most important consideration is the ocular surface evaluation. A healthy ocular surface is of utmost importance in achieving successful results with any the premium IOLs. Patients

with reduced tear film break up time, corneal surface staining and decreases aqueous production rates should not be planned for multifocal IOL implantation.Further , it is important to know from where are the aberrations emanating : Corneal or lenticular because that also helps to take a decision on the planning of these intraocular lenses.

RS: Two most important contra indications

a) Poor visual prognosis

b) Unrealistic expectations of the patient

SS: Any irregularities on cornea n optical system are the main no for MF and if patient is not understanding the limitations of this technology would be the next.

Q.3 What are the two "must to do" preoperative tests prior to multifocal IOL implantation in your practice?

GL: A- OCT macula and Optical biometry. If available an aberrometry too.

NS: The two "must do" preoperative tests, prior to multifocal IOL implantation are the tests to determine tear film production as well as its stability which includes the Schirmer's and the tear film break up time (TBUT) and the measurement of intraocular aberrations i.eaberrometry. I recommend getting an I trace done since it not only measures the total intraocular aberrations but also gives us an individual contribution by the cornea as well as the lens. If the cornea is highly aberrated, the multifocal intraocular lens implantation is best avoided.

RS: Two must do tests pre op

a) Psychological makeup of the patient

b) Visual potential and pupil size

SS: A - thorough corneal assessment by using all possible tools to detect any anomaly on cornea.

B - Patients with any retinal or macular pathology.

Q.4 One per operative surgical pearl you would like to give to a cataract surgeon while doing surgery with multifocal implant.

GL: A- Perfect anastigmatic incision, perfect rhexis and perfect IOL centration. A- Good sized

NS: Size ofcapsulorhexis is an important intraoperative parameter, which should be taken into consideration while implanting these IOLs. This has an important determinant and can adversely affect the final visual outcome. The capsulorhexis size should be such that it should adequately and equally cover the IOL, 360 degrees. The IOL should be well centred within the bag. Inadequate or differential coverage might lead to post-operative IOL decentration causing sub-optimal visual outcome as well as increased photic phenomenon. Also the IOL should be perfectly centred and the best guide are the purkinge images which should be centred when you ask the patient to look into the light. Of course the image guided systems are available, they are also useful in intraocular lens centration.

RS: To do minimal handling of tissues, well centred IOL with astigmatically neutral outcome

SS: Surgeon should assess own impact on cornea by knowing own SIA, all surgical efforts for good centration of IOL

Q.5 Do you think EDOF (extended depth of focus) IOLs score better than conventional refractive or diffractive IOLs? If yes, then how?

GL: They have their own places. People with long arms and predominantly intermediate needs do well with EDOF lenses whereas those with need for good reading vision might do better with conventional bifocal diffractive designs. Another great addition is the trifocal or quadrifocal design which gives good near and intermediate vision in addition to distance.

NS: The visual performance of EDOF IOLs have been seen to be comparable with the trifocal IOLs in terms of distant and intermediate distance visual acuity, but for near the trifocal IOLs have been seen to provide better and preferred reading distances with a more continuous range of vision. The EDOF lenses work on the principle of splitting the light. They provide 90-86% of light for distance and varying amounts for intermediate and near distances. They are that way more forgiving as they extend the focus. Depending on the lifestyle the patients and their requirements, they can be counselled.

RS: EDOF IOL has its own place. Comparison with multifocal IOL may not be fair.

SS: Yes. I always say to my patients that none of the available MF technology would match God gifted seem less multifocality, but we can reach closer but you might need some addition for near without loss of contrast sensitivity.

Q.6 What do you think is the future and standoff for the Trifocals?

GL: Trifocals are popular now and have satisfied patients but I am sure technology will continue to evolve and we will see even better designs in the near future.

NS: The trifocal IOLs provide an effective means for restoring distant, intermediate, as well as near vision with good visual quality and minimal photic phenomena. The visual

outcomes are non-inferior to that of the bifocal IOLs. The future might see an increase in the use of these IOLs.

RS: Concept of trifocals seem to have a bright future.

Needs more refining though

SS: Will improve with time but we have to learn n adjust with it in future to score better in future

Q.7 What are the two commonest causes behind an unhappy multifocal patient in your practice?

GL: Luckily I personally don't have many unhappy MFIOL patients but do see a lot of referred ones. Residual refractive error especially astigmatism and poor patient selection and exclusion are most common causes besides lack of proper counseling and building the right expectations.

NS: The most common causes of unhappiness after multifocal IOL implantation is blurred vision and the occurrence of photic phenomenon. Blurred vision is usually the result of residual ametropia and astigmatism, development of posterior capsule opacification, a large pupil size or unhealthy ocular surface. As far as the photic phenomenon are concerned, most of the times the reason for their occurrence is not identified. These visual phenomenon however lessen with time by a process of neuroadaptation within a time period of 3 months to a year. Further it is imperative to see that their tear film is optimal and of course the patient expectations should also be looked into.

RS: Reason for unhappy patients post op

a) Residual refractive error

b) Quality of vision in extreme light conditions

SS: A. If patient is not ready to understand the limitations of MF technology.

B. Hidden corneal aberrations

Q.8 Have you ever tried mixing up the multifocals? (EDOF + Diffractive or Refractive + Diffractive or EDOF + Trifocal) if yes, then which combination suits you the most?

GL: Yes, occasionally. There is no fixed combination that works best. It has to be tailored to the patient's needs and the given situation but one must give careful thought before mixing and matching.

NS: No, I don't practice mixing up of different types of multifocal IOLS, especially diffractive or refractive with EDOF intraocular lenses.

RS: No I don't normally mix.

SS: I have not such experience of mixing two different MF technology

Q.9 Have you tried multifocal IOL after refractive surgery? If yes, then what special considerations you take?

GL: Yes. One has to be very cautious. Well centred good optical zone ablations with accurate biometry and prelasik data are necessary. Again good counseling and building the right expectations helps. Not to be done as a routine though.

NS: I have never tried implanting multifocal IOLs after refractive surgery. After excimer laser ablation the cornealasphericity is altered and the cornea becomes multifocal. Planning a multifocal IOL in these eyes might lead to increase in postoperative aberrations by adding up with the corneal aberrations rather than neutralising them. One can perhaps do it, if you have sophisticated instruments like I Trace which can help to decipher the corneal and lenticular aberrations. In these cases, of course very careful planning is required.

RS: I have not done but I would consider the centration of the original treatment and induced aberrations

SS: No experience in post refractive surgery patients, I personally think MF in such patients must be avoided

Q.10 Have you been using Multifocal IOls in pediatric age group?

GL: Yes. Only bilateral implantations over the age of 8-10 years. Works very well with proper case selection. Have over 10 years follow up on some children now and they are doing well. Needs a much larger cohort to be studied in a multicentric trial for clear answers though.

NS: No, I have no experience of implanting multifocal IOLs in the pediatric age group. I believe that in children one does require a clear focus and I am unconformable in compromising on the contrast sensitivity and glare acuity in children.

RS: Not done any multifocal IOL in paediatric age group.

SS: No, since pediatric age is refractive unstable stage, therefore MF should be avoided in this age group.

At the end, we personally feel that after reading, the practitioner must be able to frame some practical guidelines in his or her practice regarding the use of multifocal IOLs.

Wishing you all the best!

Mohit Khattri

Dr. Herman Snellen

Dr. Herman Snellen (1834-1908) received his medical degree in 1857 from Cornelius Donders in Utrecht, and then joined at the Netherlands Ophthalmic Hospital until he was made professor at the University of Utrecht in 1877. Today he is best known for the vision letter-chart tests that bear his name.

Snellen left behind comprehensive work on many topics including anterior synechiae, astigmatism, accommodation, keratoconus, defective colour vision, amaurotic eyes, sympathetic ophthalmia, inflammation, diseases of the retina and connective tissue, eyeball prosthesis, the history of glaucoma treatment and eye examinations. But he is better known for his invention of a number of surgical procedures, including those for entropion, ectropion, and trichiasis.

Reference:

Arch Ophthalmol. 2011;129(5): 574. doi: 10.1001 / archophthalmol.2011.100

Congratulations

Management of Tube Exposure Following Ahmed Glaucoma Valve Implantation by Allograft Corneoscleral Rim

Shalini Mohan; Mohit Khattri; Komal Sah; Jayati Pandey; Surendra Kumar Sachan

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DOL : 10.1097/IjG.0000000000001161, PMID : 30540673
Issn Print : 1057-0829
Publication Date : 2018/12/11

ICG In Clinical Practice : Where Does It Help?

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Indocyanine green angiography was first used by cardiologists as an indicator of cardiac output. Subsequently it was used by hepatologists to study hepatic blood flow and hepatocellular function.

ICG was first used to image human choroid by Flower and Hochheimer in 1972, however its use was limited due to poor fluorescence and inability to get good quality images on infrared camera.[1] Hayashi and de Laey developed filter combinations with suffi¬cient sensitivity for near-infrared wavelengths.[2] They were also instrumental in the transition from still-frame to dynamic imaging by introducing videoangiography.

In 1992, Guyer et al. intro¬duced the use of a 1024 × 1024-line digital imaging system to produce high-resolution ICGA.[3] Finally, Yannuzzi and coworkers described a system, which had appropriate flash synchronization and image storage capability thus permitting high-resolution and long-duration ICGA.[4]

ICG is a tricarbocyanine dye. Its structural formula is 2,2'-indo-6,7,6',7'-dibenzocarbocyanine sodium salt with a molecular weight of 774.96 Da.ICG absorbs light in the near-infrared wavelength. The maximum absorption is at 790 nm, while the maximum emission occurs at 835 nm.These optical prop¬erties allow penetration through macular pigment, melanin,blood, and pigment.[5]

About 98% of ICG is bound to plasma protein.ICG is excreted mainly by liver.ICG disappears from vascular compartment at the rate of 18–24% per minute, and after 20 minutes less than 4% remains in plasma.

ICG's high molecular weight in combination with the high percentage of dye bound to plasma proteins, reduces the amount of dye that exits from fenestrations in choroidal vessels. This makes it very suitable for studying the choroidal vasculature.

The rate of side-effect is low: 0.15% with mild events (nausea, vomit, sneezing, pruritus), 0.2% with moderate events (urticarial, syncope, pyrexia, nerve palsy), 0.05% with severe events (bronchospasm, laryngospasm, anaphylaxis). However patients with a history of definite iodine allergy should not be given the dye, because of possibility of anaphylaxis.

Food and Drug Administration has classified ICG as a preg¬nancy category C drug, meaning that adequate studies for its safety have not been conducted.

INDOCYANINE GREEN ANGIOGRAPHY INTERPRETATION

Normal Eye

ICGA, one can recognize an early phase when the retinal artery is not yet filled, a midphase when both arteries and veins are filled, and a late or recirculation phase more than 10 minutes after injection. First the haler's layer gets filled followed by satler's layer and then choriocapilaris. One can clearly visualise the vortex veins in widefield angiography.

Exudative Age-related Macular Degeneration

Type 1 Choroidal Neovascularization

The Macular Photocoagulation Study recognized two forms of occult CNV:

(1) a fibrovascular pigment epithelial detachment (PED)

(2) a late-phase leakage of an undeter¬mined source (LLUS).

In case offibrovascular PED, ICGA may delineate the presence of a neovascular network usually located along the edges of the PED (Figure 1). Moreover, dynamic ICGA may reveal a feeder vessel that can be treated with laser photocoagulation if it is located outside the foveal region (Fig.).

In case of LLUS, which may represent 36–78% of occult CNV,dynamic ICGA may differentiate an occult form of CNV from retinal angiomatous proliferation (RAP). Considering that one-fourth of patients with an LLUS have a RAP and that an early diagnosis of these lesions is crucial for the func¬tional prognosis.Yannuzzi et al. found that 39% of lesions classified as poorly demarcated occult lesions by fluorescein angiography were well defined by ICGA.

Type 2 choroidal neovascularization

In classic CNV, ICGA improves visualization of the fine struc¬ture of the neovascular network allowing the choroi¬dal and retinal circulation to be distinguished. This high spatial and temporal resolution permits identification of choroidal vessels that feed into the CNV.

In early phases, ICGA shows a dark rim which corresponds to a whitish ring on infrared imaging and a discrete neovascular network surrounded by a hypocyanescent

margin which is more visible after 15 minutes. Watzke et al. showed that 87% of eyes with classic choroidal neovascular membranes were hypercyanescent with distinct edges.

It has been reported that VEGF inhibitors are more effective in controlling immature vessels, whereas a VEGFinhibitor along with a platelet-derived growth factor (PDGF) inhibitor appeared to show a synergistic effect for controlling the growth of mature vessels.

Mature, larger choroidal vessels may be readily differentiated from immature choroidal capillaries on ICGA. Thus, in patients with chronic AMD or those who do not benefit from previous treatments with anti-VEGF, ICGA helps to delineate a more mature stage of CNV. This has potential implications for therapeutic decision-making.[7]

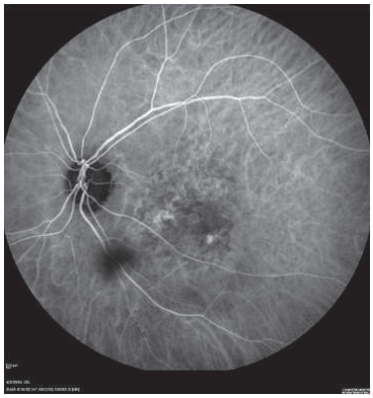

Figure 1 : Case of CNVM showing abnormal branching Vasculature over posterior pole with feeder vessel.

Type 3 Choroidal Neovascularization

Dynamic-ICGA takes up to 12 frames per second and captures progressive filling of the lesion thus allowing detec¬tion of very small and recent-onset cases of RAP.

Polypoidal Choroidal Vasculopathy

This disorder is associated with dilated tortuous choroidal vasculature with polyp like sacculations at the end. It manifests with multiple, recurrent, serosan¬guineous detachments of the RPE and neurosensory retina sec¬ondary to leakage and bleeding from the abnormal choroidal vasculature.

The early phase of the ICG angiogram shows a distinct network of vessels within the choroid (Figure 2). Larger choroidal[5] vessels of the PCV network begin to fill before retinal vessels, and PCV network fills also at a slower rate than retinal vessels. Shortly after the network can be identified by the ICG angiogram, small hypercyanescent "polyps" become visible.In dynamic angiography pulsation may also be noted in these polyps. They appear to leak slowly as the surrounding area becomes increasingly hypercyanescent. In the later phase of the angiogram there is uniform disappearance of dye ("washout") from the polypoidal lesions (Figure 3). ICGA guided Photocoagulation of these polyps has been shown to be helpful in regression of disease (Figure 4). ICG is also used to measure the greatest linear dimension of lesion and perform a guided photodynamic therapy.

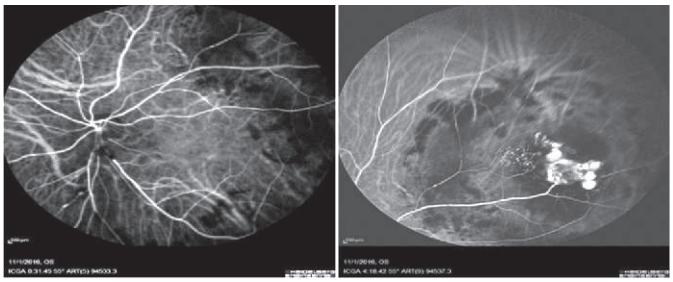

Figure 2 : Case of PCV showing extramacular blocked cyanescence with hypercyanescent polyps.

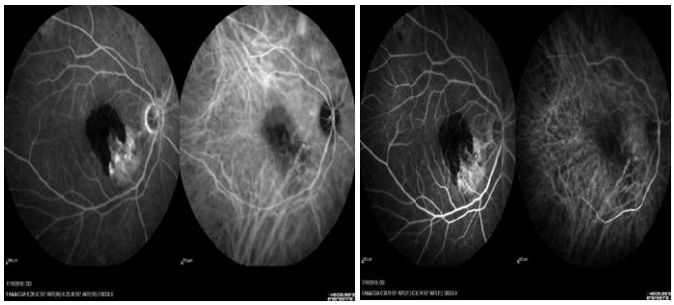

Figure 3 : Simultaneous FFA and ICG of a patient of PCV with subretinal haemorrhage showing blocked flourescence on FFA and clearly deleniating abnormal vasculature on ICGA with knobbed polyp like ending.

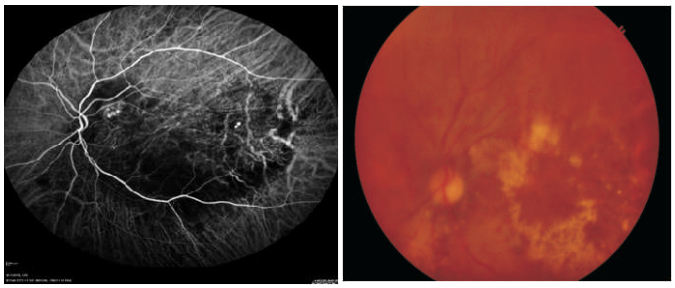

Figure 4 : Case of PCV showing ICG with hypercyanescent polyps which were extramacular and then focal laser was done

Central Serous Chorioretinopathy

CSCR is characterized by multifocal areas of choroidal hyperper¬meability which is visible on ICGA in the mid and late phases (Figure 5). Zones of choroidal hyperpermeability tend to persist in cases of severe and chronic CSC. ICG helps to localise these areas of hyperpermeability and carry out guided treatment with verteporfin photodynamic therapy or laser photocoagulation.[8] Other findings in CSC using ICGA include multiple "occult" serous PED, punctate hyperfluorescent spots, delays in arte¬rial filling of the choroidal arteries and choriocapillaris and venous congestion. ICGA is also useful in differentiating CSC from Pachy choroid vasculopathy.

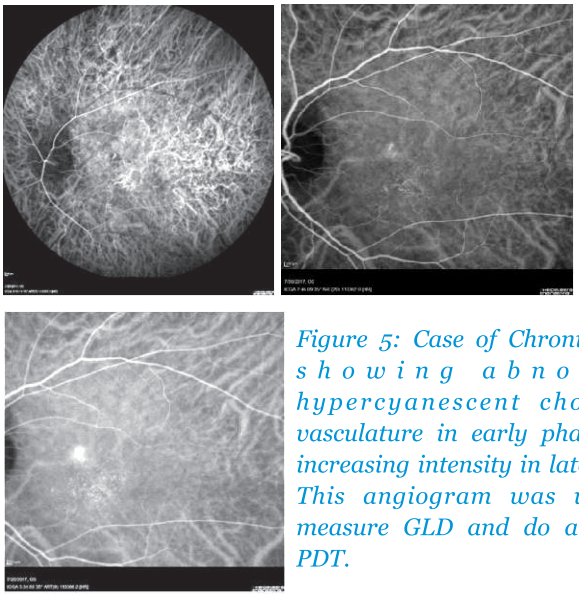

Figure 5: Case of Chronic CSCR showing abnormal hypercyanescent choroidal vasculature in early phase with increasing intensity in late phase. This angiogram was used to measure GLD and do a guided PDT.

Choroidal Tumors

Choroidal *hemangioma*

ICGA is the most useful study for demonstrating the intrinsic vascular pattern of circumscribed choroidal hemangioma. The advan¬tage of ICG dye over sodium fluorescein dye is that it diffuses very slowly out of fenestrated small choroidal vessels as compared to sodium fluorescein. Within 30 seconds of injection of the ICG dye, the tumor's intrinsic vascular pattern becomes apparent. By 1 minute, choroidal hemangiomas completely fill with the dye, showing brilliant hyperfluorescence which is diagnostic of this tumor.Thetumor vasculature has low resistance and high flow property so it allows rapid flow in and out of tumor. The result¬ing final effect is that the tumor empties faster than the normal surrounding choroid and thus appears hypofluorescent in late phase compared to surrounding choroid. This washout sign is very helpful in differentiating cho¬roidal hemangiomas from amelanotic malignant melanoma and choroidal metastases.

Choroidal *melanoma*

ICGA is capable of identifying tumor vessels which are usually irregularly tortu¬ous, with anarchic branching, dilated and have a parallel course. ICGA is superior to fluorescein angiography to clearly delineate these vessels.

Multiple Evanescent White-dot Syndrome

Multiple evanescent white-dot syndrome is a unilateral acute disease that affects young women, presenting with a transient, self-limiting visual loss. The disease involves the choroid and the outer retina. ICGA shows a pattern of multiplehypofluorescent areas at the posterior pole and peripheral retina due to slow movement of dye through the inflamed vessels. These spots become visible in the mid to late phases, range in size between 50 and 1000 µm and are more appar¬ent in ICGA images than by fundus examination and fluorescein angiography.

In addition, ICGA may show hypofluorescence surrounding the disc area. The hypofluorescent spots disappear at the recovery stage of the disease.

Multifocal Choroiditis

In multifocal choroiditis the active lesions are visualized as hypo¬fluorescent spots in ICGA images. These lesions may be followed up with ICGA and used as measure of response to treatment. A reduction in size and number of hypofluorescent spots is observed after successful treatment. Other finding visible on ICGA is a large hypofluorescent area surrounding the optic nerve (Figure 6).

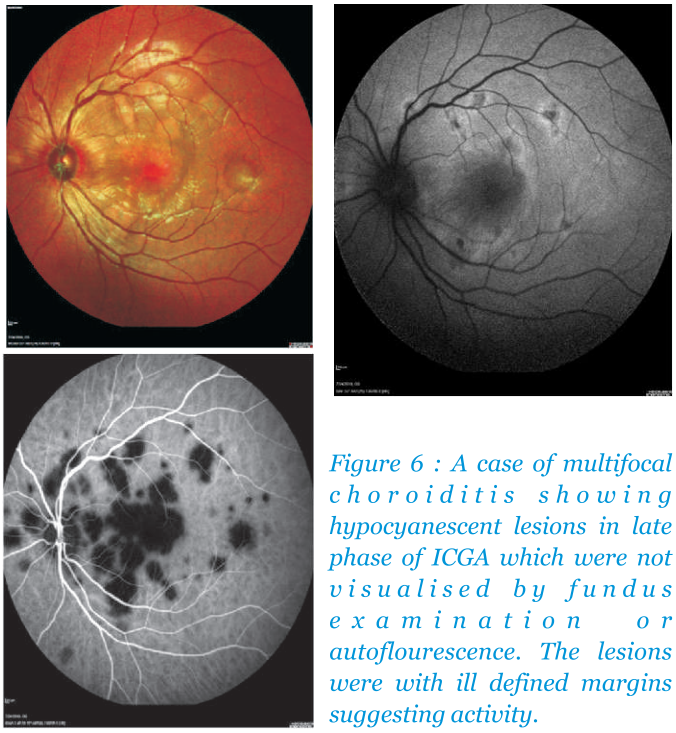

Figure 6 : A case of multifocal choroiditis showing hypocyanescent lesions in late phase of ICGA which were not visualised by fundus examination or autoflourescence. The lesions were with ill defined margins suggesting activity.

Serpiginous Choroidopathy

ICG allows better staging and identification of active lesions in serpiginous chorioretinopathy. The active lesions are characterized by hypofluorescent areas with poorly defined margins the lesions detected on ICGA may preceed the lesions seen on FFA and may also be larger in size and number as compared to FFA.[9]

Acute Multifocal Placoid Pigment Epitheliopathy

ICG of acute posterior multifocal placoid pigment epitheliopa¬thy (AMPPE) shows areas of hypofluorescence in both early and late phases that correlate with the placoid

lesions (Figure 7). These lesions may be caused by choroidal hypoperfusion, secondary to occlu¬sive vasculitis. New, activeand healed, inactive lesions in AMPPE can both be imaged and differentiated using ICGA.

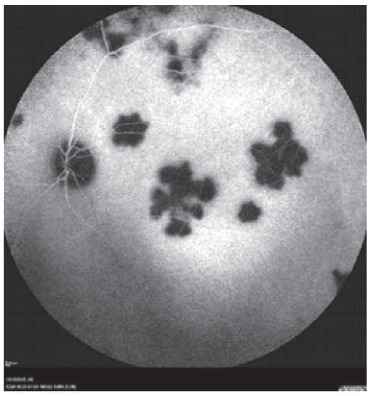

Figure 7 : case of AMPPE showing hypocyanescence corresponding to the placoid lesions.

Punctate Inner Chorioretinopathy

The subretinal lesions observed in punctate inner chorioreti¬nopathy are visualized by ICG as hypofluorescent areas through¬out all the phases of the angiogram. Another finding in ICG images is the presence of hyperfluores¬cent points situated close to the vessel wall, suggestive of vasculitis.

Acute Zonal Occult Outer Retinopathy

In acute zonal occult outer retinopathy, ICGA shows a variety of patterns of presentations. Spaide reported that the peripapil¬lary drusenoid material blocks the choroidal fluorescence in ICG and therefore the involved areas appear hypofluorescent. The secondary atrophy of the choriocapillaris produces hypofluores¬cence as well, which does not affect the fluorescence from the underlying larger choroidal vessels. In some cases, thoughICG may show an increase in fluorescence from the affected areas, due to the lack of photoreceptor outer segments and the minor blocking effect from this layer.

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JOURNAL ABSTRACT

New Stains For Anterior Capsule Surgery

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ABSTRACT:

Purpose: To investigate whether new dyes and dye combinations can give equivalent or better staining in anterior capsule surgery than existing dyes with a low degree of toxicity on relevant cells.

Setting: University laboratory of Jacobs University Bremen, Germany.

Design: Laboratory experimental study.

Methods: Pig eyes were collected post mortem. Cataract was induced by microwave irradiation. Access to the lens capsule was through open-sky surgery. Staining was performed and results were documented by photography. The toxicity of the dyes was evaluated in 3 different cell lines immediately after exposure and with a delay of 24 hours, with exposure in the dark or subsequent strong illumination.

Results: A new cyanine dye, BIP (2-[5-[3,3-dimethyl-1-(4-sulfobutyl)-1,3-dihydro-indol-2-ylidene]-penta-1,3-dienyl]-3,3-dimethyl-1-(4-sulfobutyl)-3H-indolium sodium), was found to lead to green staining, with reduced toxicity on corneal endothelial cells. Staining could be further enhanced by combining it with trypan blue. Methylene blue was very toxic, whereas its combination with trypan blue was much less toxic.

Conclusions: With BIP alone or in combination with trypan blue, safe staining of the capsule can be achieved, resulting in a green color.

Primary Posterior Capsulectomy With Irido-Zonulo-Hyaloido-Vitrectomy via An Anterior Vitrector to Prevent Relapse Of Aqueous Misdirection: A Case Series And Review Of Contemporary literature

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ABSTRACT:

Purpose

To report the outcomes of Primary Posterior Capsulectomy (PPC) when combined with Irido-Zonulo-Hyaloido-Vitrectomy (IZHV) in the surgical management of aqueous misdirection (AM) to prevent recurrence, performed by an anterior segment surgeon with an anterior vitrector via various incisional approaches.

Methods

Retrospective, non-comparative and interventional case series reporting the outcomes of reformed and sustained deep anterior chamber, intraocular pressure (IOP), anti-glaucoma medications (AGM), complications and best corrected visual acuity (BCVA) of AM management subsequent upon intervention (IZHV with PPC). A fellowship trained glaucoma specialist managed all cases with IZHV and PPCwith an anterior vitrector via ostial, corneal or pars plana incisions.

Results

Eight eyes of 7 patients with AM were treated with IZHV and PPC. AM occurred in 3 eyes intra-operatively in combined phaco-filtration surgery in primary angle closure glaucoma (PACG); rest occurred in the post-operative period. Mean follow-up was 25.4±20.8 months (range 3-66). All cases achieved reversal of AM; none developed relapse of AM. Each had deepening of anterior chamber (AC), control of IOP in mmHg (pre-IZHV 37.6±14.7,95% CI [25.3, 49.9]vs post 14.5±2.3, 95% CI [12.5, 16.4], p=0.003) and decrease in number of AGM (pre-IZHV 3.25±0.8,95% CI [2.6, 3.9] vs post 0.5±0.8, 95% CI [-0.1, 1.2], p<0.001). All except one patient recovered pre IZHV BCVA. None developed retinal break nor detachment.

Conclusions

Primary posterior capsulectomy,when combined with IZHV, is an efficient means of ensuring complete hyaloidectomy, essential for preventing recurrence of AM. It can be successfully utilised by the anterior segment surgeon through multiple incisions with an anterior vitrector, thereby reducing burden on the resources and skills required in a vitreo-retinal procedure.

Key words

Aqueous misdirection; malignant glaucoma; primary posterior capsulectomy; PPC; Irido-Zonulo-Hyaloido-Vitrectomy; IZHV;

Introduction

Aqueous misdirection (AM) or malignant glaucoma or ciliary block glaucoma has been described after a myriad of procedures[1] and even spontaneously, though typically it occurs post incisional surgery in angle closure glaucoma. It has also been reported following needling, laser iridotomy and even in the use of Pilocarpine in angle closure eyes. Anatomical predisposition thus appears to be a significant risk factor and therefore it is hypothesized to be more common in females due to relatively smaller anterior segment dimensions when compared to males. [2,3]

If surgical management is indicated, thenin recent times, Irido-Zonulo-Hyaloido-Vitrectomy (IZHV) via the anterior route has been favoured over pars plana vitrectomy (PPV), especially in pseudophakic eyes; however, both these procedures are fraught with recurrence.

In this brief report, we present the surgical outcomes of AM management with primary posterior capsulectomy (PPC) when combined with IZHV in patients who developed misdirection post intervention.

Subjects and Methods

This is a retrospective, non-comparative and interventional case series reporting the outcomes of reformed and sustained deep anterior chamber (AC), intraocular pressure (IOP), anti-glaucoma medications (AGM), complications and best corrected visual acuity (BCVA) of the surgical management (IZHV with PPC) of aqueous misdirection.

Informed consent for surgery was obtained from all the eligible participants.

Ethical clearance was obtained from the Ethics Committee; the study adhered to the principles as laid down by the Declaration of Helsinki.

VA was converted to LogMAR for computing purposes. Previous interventions included trabeculectomy, Ahmed Glaucoma valve (AGV), Nd: YAG laser posterior capsulotomy and alsorecurrent AM following pars plana vitrectomy (PPV). All of them presented either intra-operatively with non-forming anterior chamber (AC) and hard eye or within the first week of intervention with flat or extremely shallow AC and high

IOP. A fellowship trained glaucoma specialist managed all cases with IZHV and PPC with an anterior vitrector through various incisions (Figure 1) –corneal (Figure 1A), ostial (Figure 1B) or pars plana. (Figure 1C).

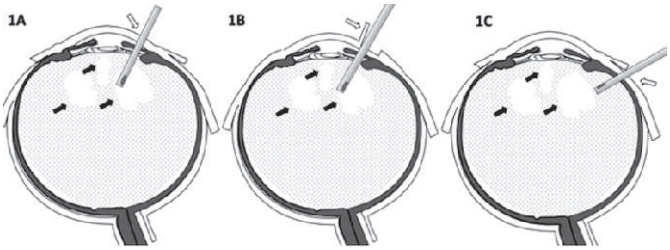

Figure 1 : 3 main routes of IZHV & PPV

Surgical method:

Pre-operatively Mannitol 20% 1-3 mg/kg body weight is injected intra-venously for deturgescence of the vitreous.

IZHV was performed via any one of three incisions – corneal if a pre-existing iridectomy was available; pars plana, if it was not. If IZHV was performed intra-operatively in trabeculectomy, or soon thereafter, then the ostium and iridectomy created as part of filtration surgery was taken advantage of.

Under peribulbar anaesthetic block, and sterile conditions, paracentesis is made at 9 o'clock position with a micro-vitreo-retinal (MVR) blade but entry into AC is usually extremely difficult. Cohesive viscoelastic is then injected, which helps to create a slit-like space of the AC. Two further ports are made - at 7 o'clock (for the right eye; 5 o'clock for the left) for the placement of an AC maintainer and the other at 3 o'clock; a corneal incision is made, with MVR blade, overlying the precedent iridectomy (Figure 2A), which may be enlarged. A 23-gauge anterior vitrector is inserted through the corneal incision almost verticallyand via the patent iridectomy (Figure 2B) to perform a zonulectomy first. The vitreous cutter initially faces the surgeon posteriorly (Figure 2 B), and once the zonules are cut adequately, the vitreous cutter is slowly rotated anteriorly, all the while cutting vitreous, until the vitrector is visible behind the posterior capsule in the anterior vitreous. It is at this juncture that the AC starts to deepen, and typically the AC 'flops' down, marking the point of reversal of AM (Figure 2C). Anterior hyaloid face is then debulked and is deemed adequate when a primary posterior capsulectomy (PPC) is performed as the last step of the procedure.

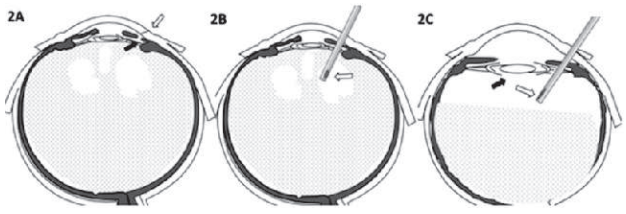

Figure 2 : Various surgical steps of IZHV & PPC (see text for explaination)

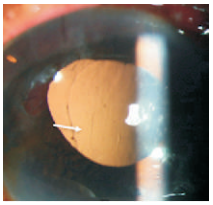

Figure 3. (Primary Posterior Capsulectomy performed intra-operatively and seen post-operatively on the slit lamp via retro-illumination technique, white arrow).

Sustained deepening of AC, without viscoelastic and AC maintainer, served as an end-point and the corneal wound was then sutured with an interrupted 10/0 nylon suture.

In situations where ostium and iridectomy are available, the 23-gauge anterior vitrector is inserted almost vertically through the pre-existing ostium and iridectomy (Figure 1B), and the procedure is completed as described before. Scleral flap is then sutured with two 10/0 nylon sutures and conjunctiva is closed routinely with 10/0 vicryl continuous mattress suture.

When an antecedent iridectomy is not available, then a conjunctival peritomy is done in the supero-temporal quadrant and a stab incision 3.5 mm behind the limbus (Figure 1C) is made at 10 o'clock with MVR blade, along with 2 other ports as described, including one for an AC maintainer. A 23-gauge anterior vitrector is introduced through this pars plana incision and advanced into anterior hyaloid; hyaloidectomy and PPC are then done. The vitrector is then advanced towards the opposite limbus, behind the iris, and zonulectomy along with iridectomy is done at this location via a posterior to anterior approach (Figure 4). The pars plana wound as well as conjunctiva is sutured with 8/0 vicryl suture.

Subconjunctival dexamethasone 2 mg is injected at the end of the procedure in all eyes.

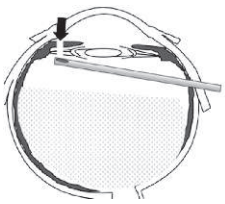

Figure 4 : Posterior approach to zonulectomy with iridectomy

Results

Eight eyes of 7 patients underwent IZHV and PPC via the ostium, cornea or pars plana stab incision using an anterior vitrector. All but one patient, were males and ratio of right to left eye was 1:1. Mean age of patients was 53.7±17.9 years and were followed up for 25.4 months. All eyes that developed AM post-operatively (n=5), except one, were pseudophakic with intraocular lens (IOL) in the bag; the only phakic eye had lens extraction along with IZHV and PPC.

AM occurred in 4 Primary Angle Closure Glaucoma (PACG) eyes; 3 of these occurred intra-operatively in combined phaco-filtration surgery (after IOL was placed in the bag), 2 in the same patient. The third patient had a history of AM post filtration surgery in the post-operative period in the phakic fellow eye and therefore lens extraction was planned to reduce the risk of AM; nonetheless the eye developed intra-operative AM.

Post-operatively, one phakic Plateau Iris Syndrome (PIS) eye developed misdirected aqueous following bleb repair. This phakic eye with AM had lens extraction and IOL placement in bag followed by IZHV with PPC through the ostium.

Aqueous misdirected in one pseudophakic Juvenile Open Angle Glaucoma eye post AGV implantation; this eye also had a history of multiple previous trabeculectomies. One vitrectomised PACG eye presented with recurrence of AM after pars plana posterior vitrectomy (PPV) and Ahmed Glaucoma Valve (AGV) performed when the eye developed AM following phaco-filtration surgery (both surgeries done elsewhere). This eye has been followed-up for a year and has not developed any further recurrence following IZHV and PPC.

All cases achieved reversal of AM with deepening of anterior chamber (AC) per-operatively as well as during the follow-up period. There was significant reduction in mean IOP and requirement for AGM at last follow-up (p=0.003 and <0.001 respectively, paired t test).All except 1 patient recovered pre-IZHV BCVA (Table 1).

Table 1. Intraocular Pressure (IOP), Anti-glaucoma medications (AGM) and best corrected visual acuity (BCVA): Pre and post Irido-zonulo-hyaloido-vitrectomy (IZHV) with primary posterior capsulectomy (PPC)

	Pre-IZHV with PPC	Post-IZHV with PPC	p value
IOP mmHg, Mean±SD, 95% CI	37.6±14.7, 95% CI [25.3, 49.9]	14.5±2.3, 95% CI [10.9, 16.6]	0.003
No of AGM, Mean±SD, 95% CI	3.25±0.8, 95% CI [2.6, 3.9]	0.5±0.8, 95% CI [-0.2, 1.2]	<0.001
BCVA, Mean±SD, 95% CI	1.21±0.8, 95% CI [0.54, 1.88]	0.73±0.74 95% CI [0.11, 1.34]	0.3

None of the eyes developed recurrence in the follow-up period. There were no intra-operative complications; one patient had choroidal exudation post IZHV. None developed a break or retinal detachment; nor was corneal decompensation, subluxation and/or dislocation of IOL seen in the follow-up period.

Summary of all cases are provided in Table 2.

Table 2: Summary of all cases undergoing Irido-zonulo-hyaloido-vitrectomy (IZHV) with Primary posterior capsulectomy (PPC)

Case no.	Gender	Age	Eye	Aetiology of glaucoma	Phakic status	Procedure inciting AM#	Timing of AM	Pre-procedure VA	Pre-procedure IOP mmHg	Follow-up in months	Re-lapse of AM	Last VA	Last IOP mm Hg	Last AGM
1.	M	84	OD	Pseudo-phakic	pseudo-phake	Trab	Post-operative Day 5	20/40 eccentric	31	12	Nil	HM	10	0
2.	M	48	OS	JOAG*	pseudo-phake	AGV (previous Trab X 2)	Post-operative Day 5	PL$	47	3	Nil	PL	14	0
3.	M	70	OD	PACG**	pseudo-phake	AGV	Post-operative Day 5	CF$$	60	12	Nil	20/80	16	0
4.	M	29	OD	PIS***	phakic	Bleb repair	Post-operative week 3	CF	30	66	Nil	20/20	13	2
5.	F	56	OS	PACG	pseudo-phake	AGV +PPV (previous Phaco-trab)	Post-operative week 6 (relapse post PPV)	CF	15	20	Nil	20/30	13	0
6.	M	58	OS	PACG	phakic	Phaco-Trab	Intra-operative	20/40	56	21	Nil	20/40	16	2
7.	M	58	OD	PACG	phakic	Phaco-Trab	Intra-operative	20/40	24	15	Nil	20/30	18	0
8.	M	27	OS	PIS	phakic	Phaco-Trab	Intra-operative	20/125	38	54	Nil	20/63	16	0

*JOAG – Juvenile Open Angle Glaucoma $PL – perception of light **PACG – Primary Angle Closure Glaucoma $$CF – Count fingers

***PIS – Plateau Iris Syndrome # AM - Aqueous misdirection

Three representative cases, of varying incisional approach for IZHV and PPC are described below.

Case 1

An 84-year-old pseudophake presented with pseudophakic secondary angle closure glaucoma 11 years after he was lost to follow-up, with a complaint of deteriorating vision in the left eye. He had undergone extracapsular cataract extraction with implant (ECCE + IOL) in the right eye in 1999 and phacoemulsification with IOL in the left eye in 2003. Visual acuity (VA) was recorded as 20/20 in the right eye and 20/40 on eccentric fixation in the left eye. IOP was uncontrolled on 5 AGM, so was advised immediate Trabeculectomy with mitomycin C (trab+MMC) in the left eye under guarded visual prognosis. However, he appeared for his surgery only 2 months later, after having discontinued all AGM for 4 weeks,with further deterioration of vision in the left eye. A routine trab+MMC was done under peribulbar anaesthetic block. His anterior chamber (AC) was a little shallow per-operatively; at conclusion of the surgery it was reformed with filtered air and cycloplegic eyedrops were instilled. Postoperative day 1 BCVA was hand movements (HM) and his AC was very shallow, with an IOP of 19 mmHg; bleb was formed and diffuse and surgical PI was patent. He was advised atropine eyedrops along with topical steroids and antibiotics and AGM was re-commenced the fellow right eye. Day 5 post-operatively his AC was flat with an IOP of 31 mmHg and patent surgical iridectomy; fundoscopy did not reveal a choroidal detachment. Misdirection process was suspected,and AGM was also commenced. Laser posterior capsulotomy and hyaloidotomy was not possible as he was unable to co-operate at the slit lamp for any length of time. He underwent IZHV and PPC under peribulbar block 48 hours later. Under sterile conditions, ZHVand PPC (as described) was done via the pre-existing ostium and patent iridectomy (which was enlarged) after having reopened the preceding conjunctival wound and scleral flap.

Post-operatively his AC remained deep and well-formed till last follow-up, a year after IZHV with PPC. His bleb was diffuse and well-formed with an IOP of 10 mmHg without AGM. His vision, however, did not recover.

Case 2

A 48-year-old one-eyed pseudophakic male presented with flat AC on fifth post-operative day following routine Ahmed Glaucoma Valve (AGV) surgery of the left eye, model FP7. His past ocular history was significant for very advanced Juvenile Open Angle Glaucoma with failure of two filtration procedures. His first filtration was 20 years ago and the second one was combined with phaco surgery 18 months prior. Just prior to AGV surgery, VA was Perception of light with inaccurate projection, and an IOP of 22 mm Hg on 2 AGM. More significantly, there was rapid deterioration in vision in the months preceding; last recorded VA was 20/63 eight months ago.

Day 5 post-AGV, VA was unchanged andIOP was 47 mmHg; the AC was flat, and the tube was barely visible in the AC (Figure 5A), having been engulfed by the iris. A large surgical PI was patent. Although he was atropinised immediately along with topical steroids, antibiotics and AGM, there was poor response to medical management. In view of his one-eyed status, IZHV with PPC was done within 2 days, through a corneal incision overlying the surgical iridectomy.

Post-IZHV and PPC on day 1, AC was deep with controlled IOP (14 mmHg)and good visibility of tube in the AC (Figure 5B). At last follow-up, VA was unchanged, IOP was borderline controlled but AC was deep.He was referred to our

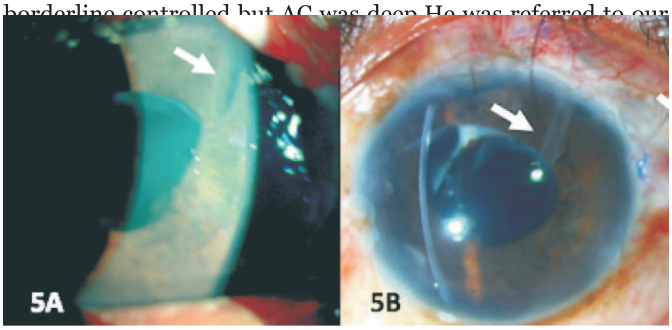

Figure 5A & 5B : Pre & Post IZHV & PPC images in AGV patient

Case 3

A 70-year-old male with PACG and pseudophakia presented with pain, redness and decreased vision in the right eye 5 days after he had undergone routine primary AGV, as superior conjunctiva was immobile. He was a bilateral pseudophake with cataract surgery having been done elsewhere, many years ago.

BCVA in the right eye was hand movements, AC was uniformly flat, cornea was oedematous with patent laser peripheral iridotomy (LPI).

Medical management was initiated but he did not respond, and AC continued to be uniformly flat as before and he continued to be symptomatic. Hence, he underwent IZHV and PPC via a pars plana stab incision, as described above.

Post-operatively day one, he was comfortable and remarked on the 'magical' disappearance of pain overnight. At his last follow-up visit, his BCVA was 20/80; AC was deep and IOP was recorded as 8 mmHg.

Discussion

Although pathogenesis of AM is still obscure, it is generally accepted that there exists a deviant relationship in the

interface between the lens, ciliary body and the anterior hyaloid face.

Stepwise management has been the historical approach to the management of AM; medical management being instituted first and foremost in the form of cycloplegics and AGM, followed by laser and then surgery.[4,5] Recurrences are frequent following cessation of medical management and success with laser hyaloidotomy is also limited (100% and 75% as reported by Debrouwere et al).[3] The aim of surgical management is to create a direct and unhindered communication between the aqueous and vitreous cavity, rendering the eye unicameral. This has traditionally been achieved by the use of pars plana posterior vitrectomy (PPV). However, core vitrectomy is more successful in pseudophakic eyes (65–90%) when compared to phakic eyes (25–50%).[6,7] It is fraught with recurrences – perhaps a reflection of inadequate hyaloidectomy for risk of damaging the lens. Therefore,not only removal of lens (with IOL implantation) but also a primary posterior capsulectomy is highly recommended in phakic eyes.

In view of the relatively high rate of recurrence, skill and cost notwithstanding, the surgical management of AM evolved, and shifted from posterior to anterior management.

At the turn of the millennium, Lois et al from the Vitreo-Retinal department of Royal Liverpool Hospital (UK)[8] reported the use of anterior vitrectomy in AM and appear to be the pioneers in describing IZHV via the anterior route in a series of five pseudophakes. No recurrence was reported over a relatively short period of follow-up (median 5.5 months).

Almost a decade later, in 2010, Bitrianand Caprioli,[9] reported the successful application of this surgical procedure, via the anterior route. These glaucoma surgeons preferred a pars plana incision for anterior vitrectomy as opposed to a clear corneal one, relieving AM intheir case series of 5 pseudophakic patients, with no recurrence in the follow-up period of 7.6 months

However, Debrouwere et al[3] in 2012, did not favour either the anterior approach as they encountered recurrence in 2 out of 3 cases, nor conventional pars plana vitrectomy (recurrence in 3 out of 4 cases). The authors favoured extensive PPV with vitreous base shaving, requiring VR expertise and resources, along with iridectomy and zonulectomy (posterior to anterior) as definitive management. It is only in this latter group that no recurrence was encountered in a series of 15 eyes. However, follow-up period is short (mean 2 months) and almost a third had a follow-up of approximately only a month, or less.

Zarnowski in 2014[10] questioned the need for the extensive surgery that was recommended by Debrouwere et al, [3] as success was found in the anterior approach, yet again. The authors favoured a clear corneal incision, in their case series of 10 patients with a mean follow-up of one year. In a deviation from our technique, they used a blade to cut through iris and zonules and into the vitreous, and only then introduced a 20-gauge vitrector to perform IZHV along with peripheral rather than axial capsulectomy.

PPV compromises conjunctiva in this sub-group of glaucoma patients, is fraught with potentially serious complications and is time-and-resource consuming. In a relatively large series of PPV in the management of AM,[11] anatomical reversal was obtained in 90% only, and serious complications like retinal detachment and endophthalmitis were reported.

Not only following PPV, IZHV alone too can be replete with recurrences.[12] Madgula et al [12] have stressed on the need for follow-up to exclude relapse even if IZHV has been successful in the short term. They experienced recurrence in 40% cases in a follow-up period of 50.2 ± 27.2 months. However, majority presented with relapse in the first 12 months, two eyes within the first week. Also, the majority of these recurrences (3 out of 4) in their case series of 10 eyes of 9 patients, appears to be due to blockage by vitreous, perhaps a reflection of incomplete hyaloidectomy.

We hypothesize that hyaloidectomy is incomplete unless one is able to perform a central primary posterior capsulectomy, and hence one of the key elements in the ill-understood mechanism of AM is insufficiently negotiated. As such, there is persistent risk of relapse, which may or may not occur. In order to eliminate the risk altogether, we strongly recommend a central primary posterior capsulectomy along with IZHV. We believe that this step is the reason why we did not encounter any relapses in our series. Furthermore, no further recurrence occurred in case 5 (Table 2), who had presented with a relapse after PPV, done elsewhere. Therefore, an extensive posterior approach, as proposed by Debrouwere et al,[3] is not mandatory. We found success by adopting our technique through various incisions with an anterior vitrector, avoiding the resources required for a posterior approach and its potential complications.

We encountered intra-operative misdirected aqueous in 3 eyes undergoing combined phaco-trabeculectomy; 2 eyes were of the same patient and the third was the fellow-eye of a patient who developed AM one week after trabeculectomy in the post-operative period. Per-operative AM was recognised by non-formation of AC and hard eye without loss of red reflex, even after lens extraction and failed intense cycloplegia. Prompt recognition per-operatively with performance of ZHV through ostium and iridectomy resulted in reversal and deepening of AC immediately, with no long-term post-operative sequelae.

We did not encounter any intra-operative complications during PPC with IZHV. Post-operatively one eye developed a

fibrinous reaction. Bleb of this eye became encysted and is controlled on AGM. Another eye developed hypotony related choroidal detachment, which settled down. None of the patients suffered recurrence in the mean follow-up period of over two years. Clinical conditions in each of our case was such that we could not delay surgery when response to medical management was poor; Wu et al[13] suggest that corneal endothelial decompensation is a palpable sequelae, specially of delayed surgery.

In our series, there was no incidence of corneal decompensation, subluxation and/or dislocation of IOL. None developed retinal break or detachment.

In the modern era, IZHV appears to be the procedure of choice for reversal of the AM process in pseudophakic eyes. We believe that it is easily adaptable in phakic eyes too, wherein lens extraction is strongly recommended, as recurrences can only be prevented if there is complete and adequate hyaloidectomy. We have presented evidence that it is versatile enough and adapts itself to multiple approaches -corneal, ostial or pars plana stab incision, all accomplished with an anterior vitrector.

Therefore, for prompt reversal of AM and its sustained long-term resolution we strongly recommend a complete anterior debulking of hyaloid and disruption of the hyaloid face, as ensured with a primary posterior capsulectomy, along with IZHV. PPC has been described (along with pars plana posterior vitrectomy) once before, by He et al[14] but the aim of this step remains unclear in their series of 30 eyes.

To conclude, in this case series of AM, primary posterior capsulectomy coupled with zonulo-hyaloido-vitrectomy, with either enlargement of a pre-existing iridectomy or creation of one, was successfully employed by a glaucoma surgeon for the relief of AM, with no evidence of recurrence in the follow-up period. It also emphasises on the fact that AM can occur in open angles too and that the treating ophthalmologist needs to be vigilant. Finally, it also highlights the fact that PPC with IZHV can be successfully utilised by the anterior segment surgeon through multiple incisions (ostium, clear-corneal or pars plana) with an anterior vitrector, for long-lasting reversal of the process of AM, thereby reducing burden on the resources and skills required in a vitreo-retinal procedure.

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Contributions of each author:

Vanita Pathak-Ray FRCS (Ed), FRCOphth (Lon) - Concept, data acquisition, data analysis and interpretation, illustrations, manuscript drafting and finalising

Gurcharan Singh MS - data acquisition, data analysis, manuscript drafting

Isha Gulati, MS - data acquisition, data analysis, manuscript drafting and finalising

Ethical approval: All procedures performed involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments.

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Topography-Guided Phototherapeutic Keratectomy For Irregular Astigmatism In A Post-Cataract Surgery Patient

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Purpose/Objective: To report the post-operative outcome of a topography-guided phototherapeutic keratectomy (PTK) for irregular astigmatism in a post-cataract surgery patient.

Methods: Case report

Case Summary: A year prior to consult, a 65 year-old female underwent an uncomplicated cataract surgery on the right eye. Patient completed all of her post-op medications and followed up regularly with her ophthalmologist at that time. During her follow-ups, her vision was unimproved and a corneal opacity was noted on the pseudophakic eye that was probably even present before her surgery. The patient was then referred to a cornea specialist in our institution. Best-corrected visual acuity (BCVA) was 20/20 for the left eye and 20/60 on the right eye. Slit lamp exam revealed an unremarkable anterior segment for the left eye but revealed sub epithelial fibrosis covering about a third of the superior aspect of the right cornea and partially involving the pupil.(Figure 1) This was confirmed with optical coherence tomography of the anterior segment. (Figure 1) Corneal topography was done and showed irregular astigmatism.[1] (Figure 2) Corneal wavefront aberration analysis, point spread function (PSF) and image simulation results were documented. Topography-guided PTK was then performed. No complications were reported and patient followed up regularly. Day 1 post-laser treatment, BCVA has already improved to 20/50 and finally after 7 weeks, improved to 20/30 +2 along with a significant resolution of the corneal opacity previously noted. Aberration analysis (Table 1), PSF (Figure 3) and image simulation (Figure 4) post laser treatment all showed a significant improvement compared with baseline.

Discussion: Excimer laser phototherapeutic keratectomy (PTK) has been found to be an effective treatment for a variety of superficial corneal disorders. Corneal surface irregularity, epithelial instability, and superficial opacity may all benefit from the procedure. It is considered a bridge between medical and surgical management of different corneal diseases and can be used for therapeutic and / or refractive indications. Visual improvement after PTK may due to reduction on scar density or removal of leukomas, as well as a reduction of irregular astigmatism. The main diagnosis and planning of PTK is based on clinical judgment, on slit lamp examination, and the amount of refractive error. Imaging techniques are used to plan and manage the postoperative outcome. Corneal topography helps in the planning and following up of patients after a PTK procedure. It also helps in correcting the pre-existing refractive error by the topography-guided laser treatment. This helps in reducing irregular astigmatism and improving visual acuity. Despite the PTK techniques available, treatment of irregular astigmatism remains suboptimal. New technology in which topographic data are incorporated directly into laser software will be helpful for the treatment of all types of astigmatism.

Conclusion: Phototherapeutic keratectomy is a safe and effective procedure in the management of superficial corneal diseases such as corneal scars, degenerations, and dystrophies. Topography Guided ablations may be utilized for difficult cases such as those with irregular astigmatism. Careful Pre-operative evaluation and regular post-operative examination helps in ensuring the best refractive outcomes.

Keywords: Irregular Astigmatism, Phototherapeutic Keratectomy, Corneal Topography, Higher order aberrations, Cataract

Table 1 : Pre & Post Operative Aberrations

ABERRATION	PRE OP	POST OP
OBLIQUE TREFOIL	-1.170	0.336
VERTICAL COMA	-1.087	1.035
HORIZONTAL COMA	0.294	0.651
HORIZONTAL TREFOIL	-1.072	-0.895
OBLIQUE QUATREFOIL	-1.135	0.315
OBLIQUE 2ND ASTIGMATISM	-0.333	-0.136
SPHERICAL ABERRATION	0.189	-0.095
WTR/ATR 2ND ASTIGMATISM	1.977	0.256
HORIZONTAL QUARTREFOIL	-0.412	-0.349

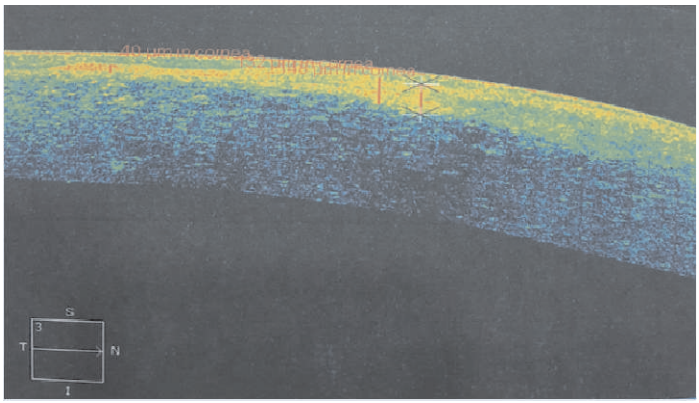

Figure 1 : Anterior segment OCT showing corneal opacity in superior third of cornea

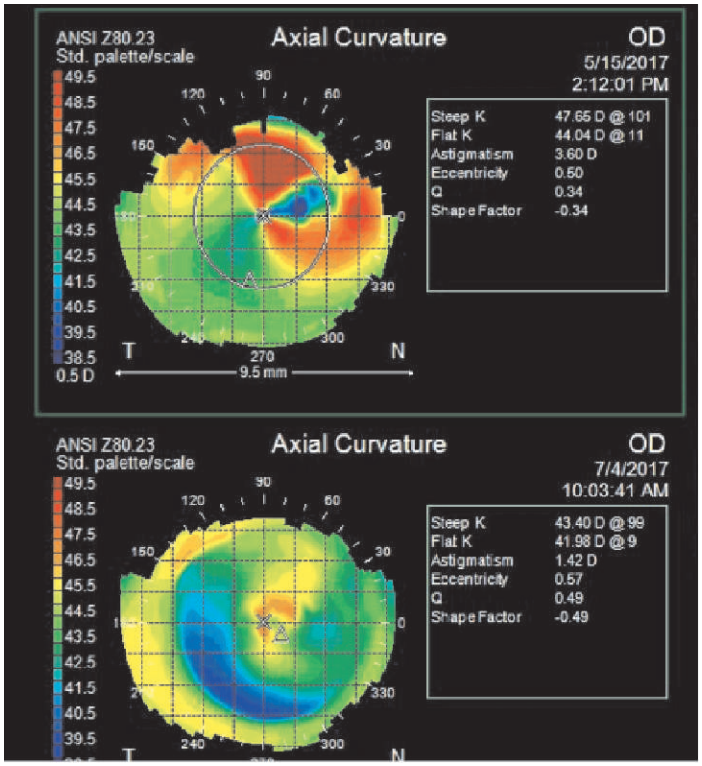

Figure 2 : Pre & Post operative corneal topography

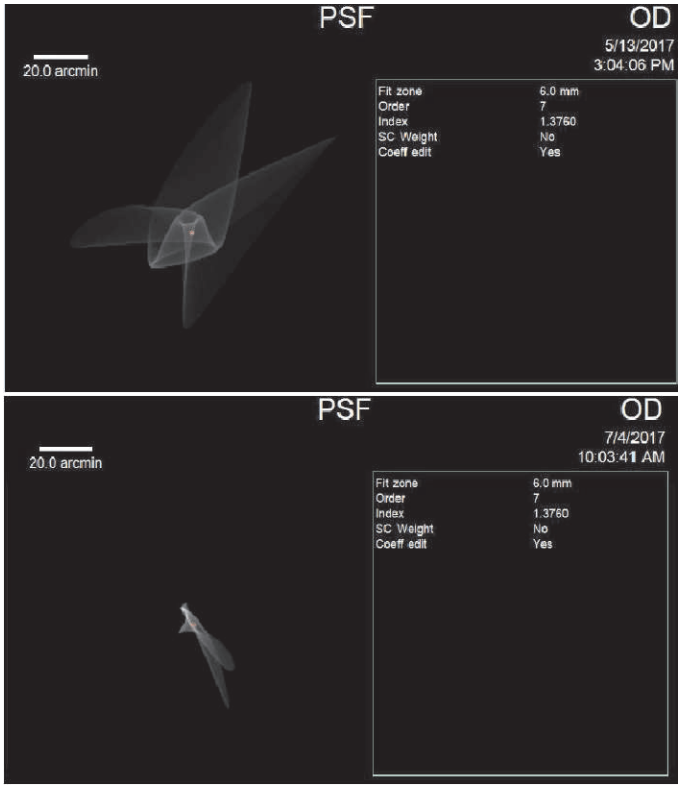

Figure 3 : Pre & Post Operative PSF (Point spread function)

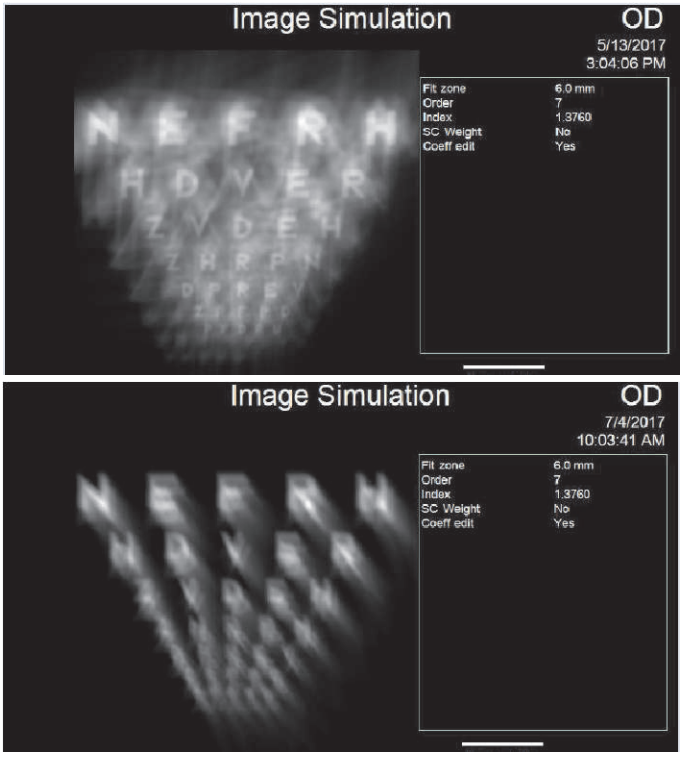

Figure 4 : Pre & Post Operative Image Simulation

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Automated Perimetry: Interpretation Of A Single Field Threshold Test Printout For Glaucoma On Humphrey's Perimeter.

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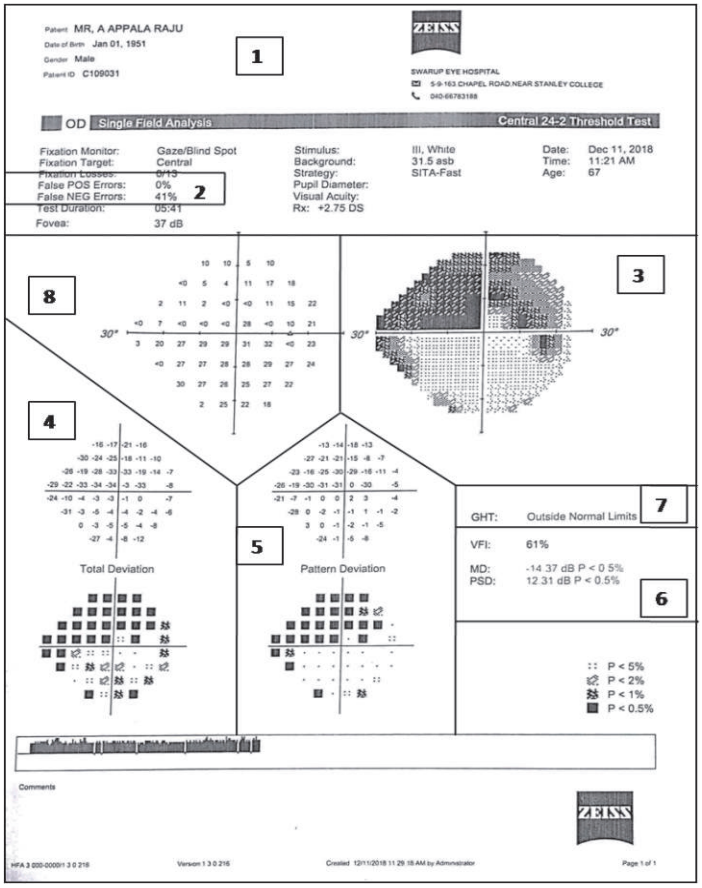
Figure 1 : COMPONENTS OF A SINGLE FIELD THRESHOLD TEST PRINTOUT – C24-2 with SITA STRATEGY



1. **Type of Test, Patient Demographics & Clinical Characteristics**
2. **Reliability Parameters**
3. **Greytone Chart**
4. **Total Deviation & Probability Plot**
5. **Pattern Deviation & Probability Plot**
6. **Global Indices**
7. **Glaucoma Hemifield Test**
8. **Raw Data**

Zone I. Type of Test, Patient Demographics & Clinical Characteristics.

Type of test-

Here we are looking at the Central 24-2 test. C signifies central. 24 signifies the central 24-degree field, but nasally 30-degree field is tested to include the nasal step. –2 is only a notation[1].

Patient Demographics-

1. Name
2. DOB should be correctly entered to enable retrieval of data & overview Analysis.
3. ID No. 4. Date of Test 5. Start Time 6. Test Duration

Clinical Characteristics-

1. Eye Treated Right/Left.
2. Stimulus III.
3. Background Illumination 31.5asb.
4. Fixation Monitor Blind spot.
5. Fixation Target Central. In central scotoma Fixation Diamond is used.
6. Strategy Full Threshold/SITA-Standard
7. Age-Interferes with sensitivity.1 decade –1.5dB drop. Hence correct age should be entered.
8. Pupil-Ideal size for perimetry is 3.5 mm. The suppression of field is more if the pupil size is between 1-3 mm than if it is 3-7 mm.
9. Visual Activity
10. Rx. More than NV correction. It can be calculated by the machine. This is a little more than the presbyopic correction, to give rest to the eye during test taking.
11. Foveal Threshold-Sensitivity in db. Abnormal values are flagged statistically.

Zone II. Reliability Parameters.

Determined by:[2]

1. Fixation Loss Rate.

2. False Positive Rate.
3. False Negative Rate.

1. **Fixation Loss Rate:** Rough measure of the number of times the patient fails to concentrate at the fixed target.

10% of stimuli in early stages (5% overall) are projected in the region of Blind Spot. If the patient responds to this stimulus, it is recorded as a fixation loss. Loss >20% is flagged XX. Upto33% is Considered OK.

Incorrectly determined OD (Eccentric OD)

Trigger Happy Patient.

2. False Positive Rate: Determined by the Analyzer setting up to project a stimulus with accompanying Click but not projecting one. Patient response is recognized.

FP >33% is flagged XX.

Implications: A Trigger-happy Patient.

Improper understanding of the Test

3. False Negative Rate: Determined when the computer projects a Suprathreshold stimulus in an already tested location. Patient's no response to the stimulus is recognized.

FN >33% is flagged XX.

Implications: An inattentative patient,

Fatigue or Malingering to produce a poor field.

Zone III. Greytone Chart.

Greytone chart is a display (a map) of all test points & locations with assigned interpolated values. Points are measured at 6 deg., but values are assigned at 1 deg. interval.

Threshold values are combined in groups of 5dB, so that the range from 1-40 is assigned 8 different shades of Grey. The higher numbers in dB correspond to lighter areas in Grey scale.

This chart gives an overall impression & is useful to explain to patient.

Zone IV. Total Deviation & Probability Plot.

Total deviation plot has two kinds of displays - Numeric & Probability Displays.

This represents the difference between the measured threshold for each test location & the age corrected normal for that location. The perimeter has stored normal data of the population and the measured threshold at each point is compared with this stored data.

Abnormal if difference is >5dB. for that age. Near the edge especially in superior hemifield, a difference >5dB. is OK.

Probability plot is linked to probability value symbols. A value P < 1% means that the measured threshold for that age and point is such that is usually seen in less than 1% of the normal population.

Zone V. Pattern Deviation & Probability Plot.

Represents difference between the adjusted threshold for each test location & the age corrected normal for that location. The perimeter adjusts the diffuse component of the suppression of retinal sensitivity. By this adjustment, the focal defects get unmasked. [1,3,4]

This adjustment is equivalent to the general change in least damaged portion. This value generally corresponds to the 7th highest value in Raw data. The probability plot is again linked to the probability symbols.

Correlation between Total Deviation & Pattern Deviation

To understand the correlation between the total and pattern deviation plots, lets use an analogy. Suppose a man while crossing the road trips and sustains an injury on his hand. Subsequently he develops fever. As a result of this injury and fever he looks quite sick (total deviation). But when we adjust his total illness by removing the general component of fever, the real hand injury gets unmasked (pattern deviation).

When we analyse this printout, the greytone chart suggests diffuse suppression of retinal sensitivity as corroborated in total deviation probability plot. But when the perimeter adjusts the sensitivity by removing the generalized change as per the least damaged portion, (eg. Cataract figure 2) the real biarcuate defect (glaucoma figure 3) gets unmasked.

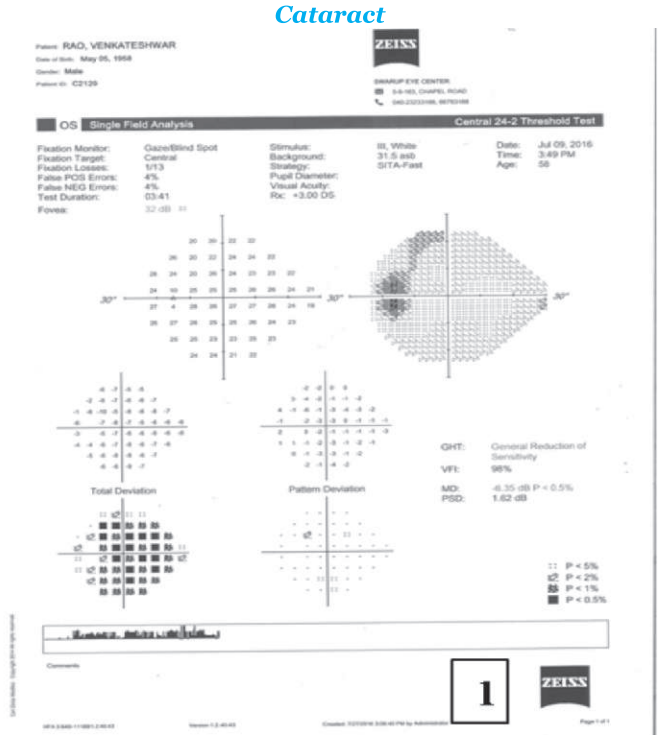


Figure 2 : Greytone chart shows diffuse suppression as corroborated in total deviation with all points normal in pattern deviation. (Likely Cataract).

Glaucoma

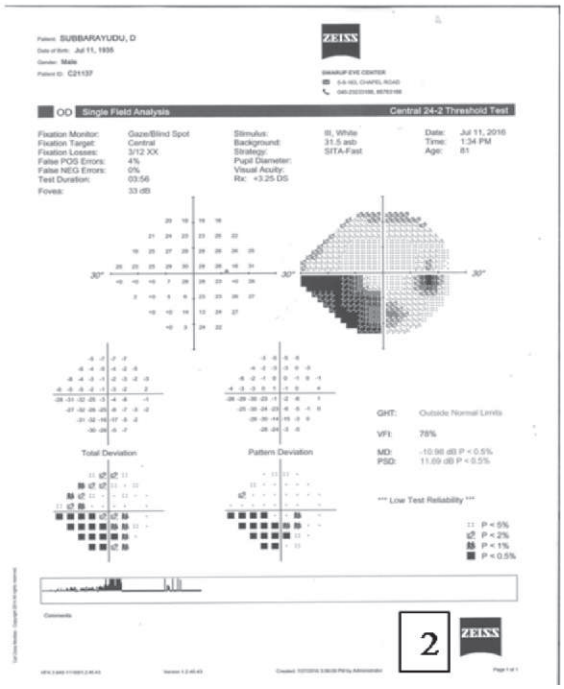


Figure 3 : Greytone chart shows inferior arcuate suppression as corroborated in total deviation with significant and exact persistence in pattern deviation. (Likely Glaucoma).

Cataract + Glaucoma

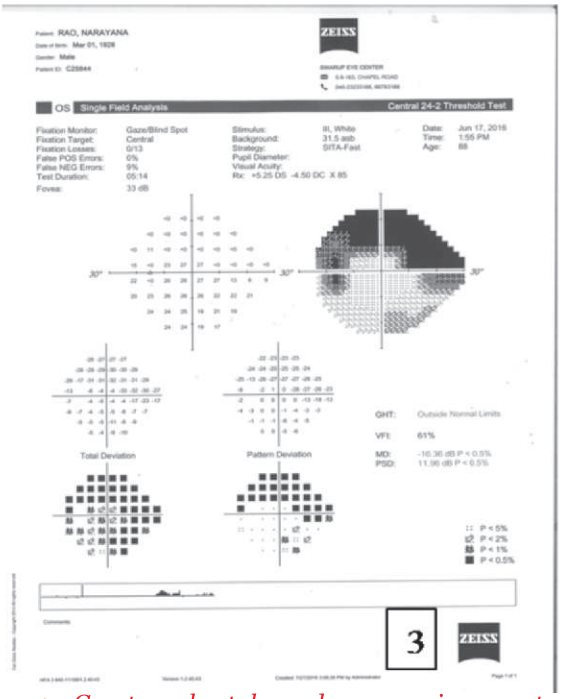


Figure 4 : Greytone chart shows dense superior arcuate defect and diffuse suppression as corroborated in total deviation with significant persistence in form of superior arcuate defect in pattern deviation (Likely Cataract and Glaucoma).

Zone VI. Global Indices.

Mean Deviation: It is the average of numbers displaced in the total deviation plot.

MD index indicates the overall severity of Field loss. It is an arithmetic mean of all the values in total deviation plot.

Pattern Standard Deviation: PSD is a measure of amount of localised depression as compared with aged matched controls.

Low PSD is consistent with smooth hill of vision. High PSD suggests local irregularities.

Mean deviation gives an indication as to how much the field / sensitivity is suppressed overall, where as PSD indicates whether this change is smooth (diffuse) or irregular (focal defects).

Visual Field Index: Whenever we tell the patient that he/she has Glaucoma, the immediate question that prop up is:[5] what is the percentage of Vision Loss? This index expresses the visual field status as a percent of a normal age-adjusted visual field.

Greater weight is given to points closer to fixation to adjust for ganglion cell density and visual function. The index may also be less sensitive to cataract and media changes.

All the global indices are marked in terms of Probability Symbols (P value).

Probability Symbols: P<5% means it is that kind of defect which may normally be seen in about 5% of the population. P<0.5% means it is that kind of a defect which may be seen in about only 0.5% of the population hence more serious.

Zone VII. Glaucoma Hemifield Test.

Calculated by comparing 5 Zones in the upper hemifield with identical locations in inferior field after adjusting for general height of vision.[6]

It gives information about threshold value between the two halves of the field.

Results –Glaucoma Hemifield Test. We get 5 different types of results.

1. Within Normal Limits: No significant difference & sensitivity is within 99.5% of range.
2. Outside Normal Limits: Difference between two halves greater than would occur in 99% of normal population. ie., the defect is such that is seen in 1% of the population.
3. Borderline: Difference between the two halves greater than would occur in 97% of normal population. ie., the defect is such that is seen in 3% of the population.
4. General Reduction of Sensitivity: Overall sensitivity of the least damaged portion is below99.5% range, but there is no difference between the two halves.

5. Abnormal High Sensitivity: Overall Sensitivity is higher than in 99.5% of population.

Zone 8. Raw Data.

This is a display of all threshold values measured at every point.

Redetermined 10 cardinal points are shown in Parenthesis. These points are redetermined to give an index of SF variation. Apart from these points, the other points that are redetermined are points that are 5dB. less than expected normal. The points with a difference of >6dB. between the adjacent points are also redetermined.

SYSTAMATIC INTERPRETATION OF A SINGLE FIELD THRESHOLD TEST PRINTOUT- C24-2

For a proper interpretation of a printout, we have to answer the following questions.

1. What Type of Test is performed?
2. What are the Patient Demographics & Clinical Characteristics?
3. Is the field reliable?
4. Is the Visual Field abnormal?
5. What is the Pattern of Abnormality?
6. Is the Field worsening?
7. Is the abnormality due to disease or artifact?

1. What Type of Test is performed?

C24-2

2. Patient Demographics & Clinical Characteristics.

As discussed above.

3. Reliability Parameters.

As discussed above.

4. Is the Visual Field abnormal?

To know this, we have to consider:

1. Threshold Printout.
2. Foveal Threshold.
3. Greytone Chart.
4. Total Deviation & Probability Plot.
5. Mean Deviation.
6. Glaucoma Hemifield test.

5. What is the Pattern of Abnormality?

To know this we have to consider:

1. Greytone Printout.
2. Pattern Deviation numeric & probability Plot.
3. Glaucoma Hemifield Test.
4. PSD/CPSD.

6. Is the Field worsening?

By comparing the Baseline Field with subsequent Fields.

Important to differentiate Long-term fluctuation (LF) with real worsening.

Depression in some points & Improvement in others suggest LF.

Proportionate Change suggests Worsening.

Progression of Field Defect can be ascertained by:

1. Point wise Comparison.
   a) New Defect in an expected location, which is significant.
   b) Expansion of an existing defect
   c) Worsening of an existing defect.

The Defect is considered to have worsened if two or more non-edge points within or adjacent to an existing scotoma have worsened by at least 10db. or 3 times the average of the short-term fluctuations, whichever is greater.

2. Glaucoma Change Probability.
3. Regression analysis of Global Indices.

7. Is the abnormality due to disease or artifact?

The artifacts that should be ruled out include

1. Incorrect DOB. The result is compared to the normal data of a different age and wrong analysis is obtained.
2. Incorrect Refraction. This may result in diffuse suppression of the field.
3. Incorrect Fixation. This generally underestimates the defect.
4. Effect of Pupil Size. Miosed pupils show diffuse suppression
5. Dim Projector Bulb. Overall suppression of field may be seen. Here the brightest stimulus can be shown < 1 dB instead of <0 dB.
6. Long term Fluctuation. As already described.
7. Lens Rim Artifact. We generally get a circumferential suppression of sensitivity in the periphery.
8. Edge Artifact. The sensitivity decreases as we move to the periphery. Isolated defects outside 24 deg. are usually edge artifacts.
9. Lid / Brow Artifact. Manifests as a kind of superior arcuate defect.
10. Fatigue Effect: The cardinal points that are tested early are normal but the peripheral points are suppressed.
11. Learning Effect: Here the cardinal points that are tested early are suppressed as seen encircled in the figure. Subsequent field test shows normal sensitivity.

To know whether the defect that we are looking at is significant or otherwise, we have to see whether it is as per Anderson's criteria.

ANDERSON'S Minimal Abnormality Criteria for Glaucoma:

1. Three or more non-edge adjacent points in an expected location in cen.30 deg.field- that have P<5% on Pattern deviation, one of which must have P<1%.
2. Glaucoma Hemifield Test "Outside Normal Limits."
3. CPSD/PSD with P< 5%.

REPORTING OF A SINGLE FIELD THRESHOLD TEST PRINTOUT- C24-2

- Report Patient's name, age & Clinical Characteristics
- Report the Type of test done in each eye
- Comment on the Foveal Threshold.
- Comment on reliability Parameters.
- Comment on the Foveal Threshold.
- Give an overall view of the Greytone Chart & its corroboration with the Total deviation Chart & Probability plot
- Comment on "Significant" Persistence in Pattern deviation chart & Probability plot.
- Comment on Global Indices with special reference to CPSD/PSD.
- Comment on Glaucoma Hemifield Test.
- Comment on final review of Raw data if required.
- Final Impression: with suggested clinical correlation.

In Synopsis, to confirm a positive Glaucomatous defect

- Give a Preliminary look at the Greytone Chart. Note the foveal threshold.
- Corroborate it with Total deviation plot
- Look out for Significant Persistence in Pattern deviation plot
- Confirm this defect with PSD/CPSD & analysis of Raw Data.
- This defect should then be correlated clinically to OD Change & other parameters.

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The Subtle Signs Of Trachoma

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Trachoma in a clinical setting of signs without symptoms is a challenge to identify. Imagine a patient who wants a multifocal IOL for cataract surgery and the subtle signs of trachoma are missed. Eyelid evaluation is most underrated aspect of cataract surgery with disastrous complications.

Trachoma risks are higher older individuals who have difficulty in bathing themselves especially in winter or women who don't wash hair frequently and miss eyelashes causing lower lid hygiene in paradoxically middle to high socio economic groups. In these individuals the classical signs of Trachoma like Herbert's pit and sub tarsal scarring are very rare. It is more common to see discharge on eyelid and other eyelid changes. Eye cosmetics applied with unwashed bare hands or shared between family also increase risk. Systemic factors like diabetes, old age, dementia, deafness can make treatment of trachoma difficult or refractory.

During clinical examination it is essential to note the position of eyelashes and skin colour. The discharge on eyelids in trachoma can be at the base of eyelashes and can be skin coloured needing high degree of clinical suspicion to identify. Discharge can be scarce and gets missed if slit lamp magnification is not increased. Misdirection of eyelashes is very common which needs lower slit lamp magnification to identify. Slight degree of misdirection which brings eyelashes together is common as compared to gross trichiasis. Rubbing of eyelashes against conjunctiva or cornea can lead to paracentral macular grade opacities and chronic changes on conjunctiva due to irritation. Thinner eyelashes especially near the edges of eyelids get easily misdirected as compared to thicker central ones. Opacities are frequently macular grade needing lower and diffuse slit lamp magnification with higher illumination to diagnose. These patients frequently seek lubricants for irritation. Infection of the follicle of eyelash can give rise to a partially depigmented eyelashes with a black tip and whitish base. Poliosis is complete depigmentation and has low specificity as it can be associated with ageing. Compared to Poliosis partial discolouration of eyelash is very common with trachoma. I prefer to cut eyelashes if partially discoloured or covered by non resolving discharge before surgery as I consider them infected.

Another important aspect of eyelid evaluation is health of posterior lid margin and the thickness of lid margin. Too thick margins with loss of sharpness of eyelid margin can be associated with mebomianitis or Trachoma. Co-existing mebomianitis might increase lipid secretion during surgery after applying speculum as patient presses eyelids against speculum. The release of lipid which can also carry bacteria on eyelid allowing them to enter eye during surgery. Pressing of eyelids before surgery might express the lipid out of eyelids. Such individuals need pressure on eyelids with cue tip to diagnose mebomianitis just as we use roplas to diagnose chronic dacryocystitis.

A regressed pannus is identified by looking for asymmetrical thickening of corneal arcus at superior limbus. This is due to extra lipid deposition by pannus. On regression corneal blood vessels are very difficult to identify. Conventional teaching divides signs of trachoma into three aspects of sequela, acute or chronic disease. In clinical practise it is common to see a mixture of sequela with chronic signs in patients who do not have redness. Treatment is with azithromycin eye ointment applied three to four times for 3 weeks. It is essential to stress lid hygiene or explain lid scrub to patients as just application of ointment does not clear the eyelash infection which can be in the form of cylindrical discharge. I also prefer to cut eyelashes so that lid base is accessible to ointments and scrubs.

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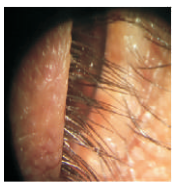
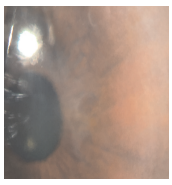
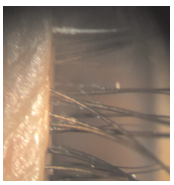
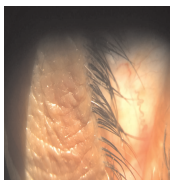
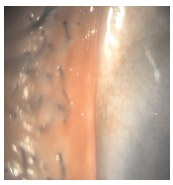

Discharge on eyelashes

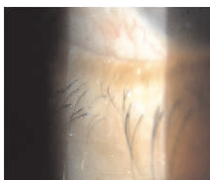

Macular grade corneal opacity


Mebomianitis


Misdirection of eyelashes


Partially Discolored Eyelashes


Regressed Pannus


Tylosis and mebomian gland abnormalities

CURRENT CONCEPTS IN MANAGEMENT OF DIABETIC MACULAR OEDEMA

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INTRODUCTION

Diabetic macular oedema is a multifactorial major cause of blindness worldwide. The disease involves breakdown of blood retinal barriers and oxidative stress. It involves the release of various growth factors including vascular endothelial growth factor.Control of systemic comorbidities like hypertension and dyslipademia play an important role. Ophthalmic treatments include monotherapy or a combination therapy of laser and intravitreal pharmacologic treatments like intravitreal Triamcinolone Acetonide, Dexamethasone or Fluocinolone implants, anti VEGFs like ranibizumab, bevacizumab or Aflibercept. Following FDA approval ranibizumab and aflibercept have become the first line of therapy. Anti VEGF therapy has changed the entire management of diabetic macular oedema. Focal laser treatment is still a preferred method of treatment for non center involving macular oedema. The Early Treatment Diabetic Retinopathy Study (ETDRS) showed that focal photocoagulation in eyes with macular oedema (Figure 1) showed considerable improvement. The high intensity of laser burns used in ETDRS was associated with enlarged scarring, restricted visual fields and development of choroidal new vessels.

Intravitreal anti VEGFs have shown good results with minimal side effects. They have shown a mean visual improvement of 8 to 10 ETDRS letters.[1] Intavitreal injections need to be repeated every month. Intravitreal steroid implants have been considered where anti VEGFs fail to show desired results. Steroids are now being used as primary line of therapy also, since macular oedema in diabetics has been shown to be a result of various inflammatory factors apart from VEGFs, lie interleukins and chymotrypsins.[1]

MORPHOLOGICAL PATTERNS ON OCT IN DME

1. **DIFFUSE RETINAL THICKENING** appears as areas of increased retinal thickness with areas of reduced intraretinal reflectivity compared with retina without thickening (Figure 2A).
2. **DIABETIC CYSTOID MACULAR OEDEMA** appears as ovoid areas of low reflectivity separated by highly reflective septae that represent intra retinal cystoid like cavities (Figure 2B).
3. **POSTERIOR HYALOID TRACTION** Tangential traction exerted by the posterior hyaloids on the retina can be seen as a highly reflective band on the retinal surface.
4. **SEROUS RETINAL DETACHMENT NOT ASSOCIATED WITH POSTERIOR HYALOID TRACTION** A dark accumulation of sub retinal fluid is seen beneath the dome shaped elevation of the retina is seen. A highly reflective band which represents the outer surface of the detached retina, differentiates SRF from intra retinal fluid (Figure 2D).
5. **POSTERIOR HYALOID TRACTION AND TRACTIONAL RETINAL DETATCHMENT** PHT is seen as highly reflective signal arising from the inner retinal surface. TRD is seen as an area of low intensity signal underlying the highly reflective border of detatched retina. TRD often takes on a peaked configuration (Figure 2C).

MANAGEMENT GUIDELINES

A good metabolic control is mandatory for all patients undergoing treatment. Treatment starts with comorbidities like control of blood pressure, dyslipidemias etc.A thorough ocular examination including vision, intra ocular pressure, slit lamp examination, dilated fundus examination,+90 D examination, OCT and FFA are done.

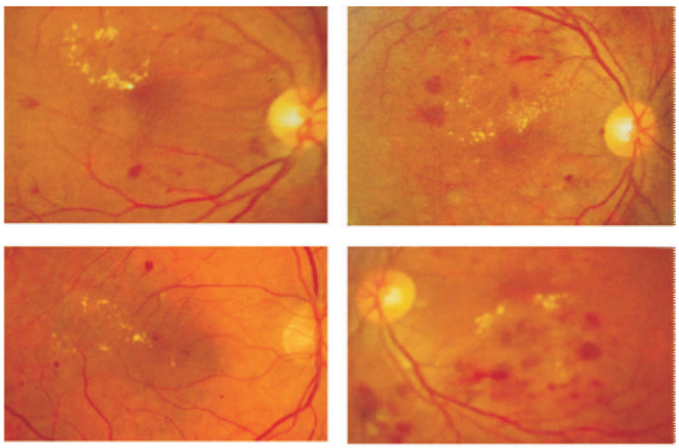

Figure 1 : Clinically significant macular edema

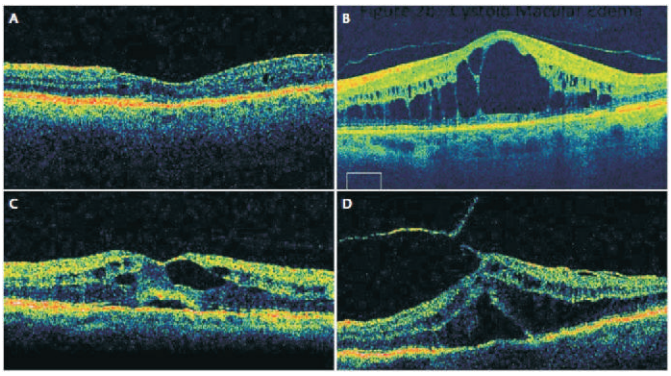

Figure 2 (A) : Diffuise retinal thickining
(B) : Cystcid macluar edema
(C) : Sub macular fluid with noPHT
(D) : DME with PHT

Several randomized control trials have evaluated the role of laser, anti VEGF intravitreal injection and intravitreal corticosteroid implant. They carry various levels of evidence. Laser therapy is done in non center involving DME and intravitreal anti VEGF /corticosteroid implant in non center involving DME. At the same time blood pressure levels of 130/80 or lower and hbA1c levels of less than 7 mg/dl are known to prevent progression of retinopathy.[2]

Five major groups have published guidelines for treatment of diabetic macular oedema –the American guidelines, the European guidelines, the Canadian guideline, International Council of Ophthalmology guidelines and the Asia pacific guideline.[2] All of them have inferred that the mainstay of treatment of DME has shifted from laser to intravitreal anti VEGFs and intravitreal dexamethasone implants. All guidelines mentioned initial loading doses of anti VEGF injection and repeat monthly injections till there is clinical improvement and macula is dry on OCT.[2]

In the care of DME two clinical tests –documented visual acuity with and without correction,measurement of IOP and two diagnostic tests FFA and OCT are of great importance. Both RESTORE STUDY and DRCR.net have considered anti VEGF monotherapy. RESTORE study recommends [3] loading doses of ranibizumab, then suspend treatment if vision is stable, continue treatment if it is not, restart treatment if DME worsens after initial stabilization. DRCR.net also recommends [3] loading doses followed by further injections till the macula becomes dry, then suspend therapy and continue if oedema recurs. Other three guidelines, the Canadian, the European and the Asia Pacific Guidelines recommend a combination therapy of intra vitreal injection and laser for non- centre involving DME and Ranibizumab monotherapy for centre involving DME.[2]

Retinal photocoagulation produces its beneficial effect by the following mechanisms :

1. Destruction of metabolically active cells and thus decreasing the ischaemic drive and secretion of angiogenic factors.
2. Reduction of total oxygen demand and improving intra retinal oxygen delivery.
3. Vasoconstricive effect and hence decreased exudation.
4. Facilitation of PVD induction.

Anti VEGF injection regimes

The RISE and RIDE trials established the superiority of anti VEGF injections over focal laser.[3] These studies were designed to establish treatment superiority over focal laser. They were modeled after earlier studies where monthly injections were given for the treatment of DME.

The advantages of monthly treatment was that it lead to rapid visual acuity improvement and the gain was maintained for atleast 3 years. The other main advantage was regression of diabetic retinopathy(DR).With monthly treatment patients experienced regression of 2 or more steps in DR score.

Disadvantages of monthly treatment included financial cost to the patients and insurers. Patients had to spend lot of time travelling to office every month. Family members had to share this cost further increasing the indirect burden.

PRN TREATMENT

In contrast to the monthly injections in monthly treatment, in PRN protocol anti VEGF injections are administered on the basis of presence of DME on fundus examination and on OCT.

PRN regime required frequent visits to the clinic to monitor the disease and treat if required.In DRCR.net protocol 1 the average number of visits were 13 in the first year,which decreased in the subsequent years.The advantage was a robust increase in visual acuity followed by stabilization and a decrease in the number of injections over time. However, the burden of visits still existed.[3]

TREAT AND EXTEND PROTOCOL

Based on the above responses most retina surgeons are shifting to treat and extend protocol over the past years. In this regimen the physician administers intra vitreal injection at each visit, but instead of a fixed monthly interval, the length of the interval varies depending on disease activity. On presentation, eyes are often treated monthly until macular edema resolves or until there is no further improvement in macular edema or visual acuity. As soon as the eye is deemed to have no edema, stable visual acuity, or stable macular thickness on OCT over several visits, a baseline has been established. The treatment interval is then extended by 1 to 2 weeks at a time, as long as vision and macular edema remain stable. If macular edema recurs or the visual acuity decreases, the interval is shortened by 1 to 2 weeks until the eyes return to their baseline.

A treat-and-extend regimen has several potential advantages. Unlike with a PRN schedule, the clinician does not have to wait until macular edema is worse before treating the patient. Chronic macular edema can lead to irreversible vision loss, so preventing recurrence of edema can potentially preserve visual acuity in the long term.

A treat-and-extend regimen can also reduce the number of office visits without sacrificing visual acuity. One retrospective case series compared a visual acuity–guided PRN (VAPRN) protocol with an OCT-guided treat-and-extend (OCTAE) regimen in patients with DME treated with Ranibizumab.[3] At 1-year follow-up, there was no significant difference in visual acuity (+8.3 letters vs. +9.3 letters) in the VAPRN and OCTAE groups, respectively, although the VAPRN group required fewer injections (5.9 vs. 8.9) than the OCTAE group ($P < .001$).[3] It is not clear whether these visual acuity and OCT outcomes would be maintained over time.

In another retrospective series, the mean number of injections using a treat-and-extend regimen was 8.8 over a 2-year follow-up period with a mean injection interval of 11 weeks.

A multicenter randomized study recently compared Ranibizumab for the treatment of patients with DME administered in one of three regimens: monthly, or on a treat-and-extend basis either with or without macular laser administered at month 1 and again every 3 months based on microaneurysm leakage on fluorescein angiography.At 1 year, mean BCVA was not statistically significantly different among the three cohorts. Although there was no difference in BCVA among the groups, the number of injections required to achieve these visual acuity gains was significantly lower in both treat-and-extend groups compared with the monthly group (10.7 injections for treat-and-extend without laser, 10.1 injections for treat-and-extend with laser, and 13.1 injections for the monthly group; $P = < .001$).[3]

INTRAVITREAL STEROID IMPLANTS

Diabetic macular oedema has been shown to be a result of several inflammatory factors other than VEGF. Anti inflammatory effect of dexamethasone is rapid and may produce beneficial effects within a week of treatment. Steroid administration may reduce VEGF expression, attenuate leukostasis, and vascular leakage and decrease the production of proinflammatory cytokines. The fact that dexamethasone is able to improve DME symptoms in patients refractory to anti-VEGF suggests that in these cases inflammatory mediators may have a more important role than VEGF in disease development.[3]

Dexamethasone implant helps in improvement of visual acuity as also a decrease in CMT. The effect of dexamethasone implant lasts for 6 weeks.Very rarely repeat injections are required. Very few complications like cataract formation or raised intraocular pressure have been reported. Intravitreal steroid implant may be used as a primary line of therapy in DME patients who are pseudophakic or are waiting for cataract surgery. It is also recommended for all recalcitrant cases not responding to repeat intravitreal anti VEGF injections.[4]

PERIPHERAL ISCHAEMIA

Peripheral ischemia is an important finding in eyes with DME , which is highlighted even more by new technological advances in wide-angle fluorescein angiography. The modern approach suggests that treating this peripheral ischemia is a pivotal issue in DME therapy. Peripheral ischemia leads to up-regulation of VEGF and ablation of the periphery would result in down-regulation of VEGF. Peripheral laser photocoagulation enhances formation of posterior vitreous detachment (PVD) ,which enhances DME resolution.

To prevent immediate worsening of DME after peripheral laser, anti VEGF injection with or without steroid implant are given prior to laser photocoagulation. Photocoagulation leads to increased oxygen supply to the remaining retina, especially the area of macula. This results in retinal vasoconstriction and a decrease in DME, avoiding the need for both focal therapies of the posterior pole and repeated anti-VEGF injections.

CLINICAL SITUATIONS

1. **Macular oedema, center involved, good visual function**

   One should treat with anti VEGF therapy because the macular centre is involved. Patient might be reluctant as the vision is good in this case. While the discretion lies with the treating physician, one could consider just observation if the vision is good and the macular oedema non cystic. A good metabolic control is off course mandatory.[2]

2. **Macular oedema, centre involved, compromised visual function**

   Anti VEGF therapy or intravitreal dexamethasone is the treatment of choice. The patient should be counseled that he will have to return to the clinic for regular follow ups and further treatment if required. The risk of cardiovascular complications and development of cataract or raised intraocular pressure must be explained to the patient.

3. **Macular oedema with vitreomacular traction**

   Vitreous surgery with or without ILM peeling is the treatment of choice. Anti VEGF injections should not be used as they further worsen vitreo macular traction.

4. **Macular oedema, center involved, no vitreomacular traction**

Vitreous surgery may be considered only after exhausting all possible options.

INDIAN DIABETIC MACULAR OEDEMA GUIDELINES [2]

One need not intervene in eyes with minimal vision reduction (20/20–20/25) irrespective of macular involvement. One should decide to treat with laser in noncenter-involving macular edema and anti-VEGF in center involving macular oedema.

Anti-VEGF therapy or implantable dexamethasone treatment becomes mandatory in center-involving DME with moderate to severe vision loss. Intervention when the vision is still good (>20/40) is likely to give better results. Because of possibilities of increased IOP and early cataract formation in phakic eyes associated with dexamethasone implant, the anti-VEGF injection is favored more often as the first line treatment. Anti-VEGF therapy should be continued till macular edema improves and vision is stable. A laser therapy (deferred laser) could be considered as it will reduce the number of injections; however, this is not evidence based.

Change of therapy is indicated in nonresponders or recalcitrant situation. The options are either change to another anti-VEGF or use implantable dexamethasone. Increase in IOP is a concern though the MEAD study has shown that the IOP rise in each treatment cycle is temporary and returns to baseline between two treatment cycles.

Finally, vitrectomy should be reserved for refractory cases not responding to any of the above-mentioned therapies. Vitrectomy is also necessary in eyes with documented vitreoretinal traction or when all options are exhausted . DRCR.net study has suggested that poor presenting vision and removal of epiretinal membrane are associated with superior visual gain following vitrectomy.[2]

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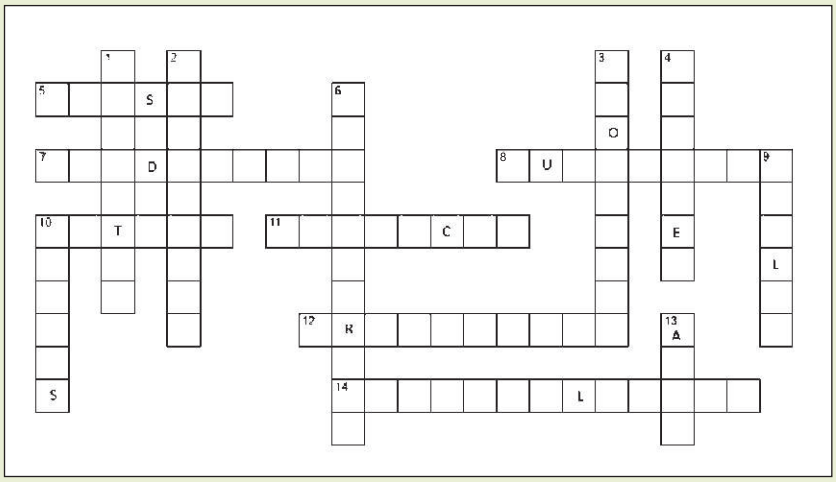

ACROSS
5 An eyelid disorder
7 Corneal graft rejection
8 A Retinopathy
10 A stereopsis test
11 An Ophthalmic instrument
12 An Aeging process
14 A scotoma

DOWN
1 An imaginary plane
2 A drug causing uveitis
3 A symptom
4 A line in Pterygium
6 Anti-Glaucoma
9 An inventor
10 An intraocular lens
13 A pupil

The correct answers can be mailed to editorupsos 2018@gmail.com

Lens Anterior Capsule Opening Procedures

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ABSTRACT:

Manual Small Incision Cataract Surgery (MSICS) and phacoemulsification are two of the most commonly performed cataract surgeries worldwide. The opening of the anterior capsule step is arguably the most critical for a successful MSICS and phacoemulsification. Technique employed for this task have undergone sustained evolution from Vogt technique to can opener capsulotomy and continuous curvilinear capsulorhexis and evolution of new instruments and machines from cystitome, capsular forceps to laser assisted capsulotomy helped the surgeon to achieved continuous, curvilinear and circular capsulorhexis. Each technique have their own advantages and disadvantages. The mechanical capsulotomies that are performed by femtosecond laser and zepto are functionally similar to capsulorhexis but much more expensive in cost. Manual capsulotomies are still performed where mechanical capsulotomy is not feasible. This article discusses the technique, advantages, disadvantages and complication related to continuous curvilinear capsulorhexis.

Introduction

Manual small incision cataract surgery (MSICS) and phacoemulsification are two of the most commonly performed cataract surgeries worldwide. The opening of the anterior capsule step is arguably the most critical for a successful MSICS and phacoemulsification. The capsulorhexis or mechanical capsulotomies are the best methods for opening the anterior capsule. The capsulorhexis should be continuous, curvilinear and circular. The opening is created by a controlled shearing and tearing of the anterior capsule by either a needle cystotome or capsulorhexis forceps. The mechanical capsulotomies that are performed by femtosecond laser and zepto are functionally similar to capsulorhexis but much more expensive in cost. Manual capsulotomies are still performed where mechanical capsulotomy is not feasible.

Evolution of the Anterior Capsule Opening Procedures

1. Manual Capsulotomy
   - 'Can-opener' or multi-puncture capsulotomy
   - Envelope capsulotomy
2. Manual capsulorhexis
3. Mechanical capsulotomy

A. Laser Assisted Capsulotomies
   - Femto Laser assisted capsulotomy
   - Zepto Laser assisted capsulotomy

B. Radio frequency-assisted capsulotomy

Evolution of Capsulotomy Instruments and Machines

Manual

- Cystotome or Capsulotome
- Capsular Forceps

Mechanical

LASER-assisted Capsulotomy

- Femto Laser-assisted capsulotomy
- Zepto Laser-assisted capsulotomy

Other Modalities

- Fugo Blade
- Radio frequency Diathermy

Manual Capsulotomies

1. 'Can-opener' or multi-puncture capsulotomy

A circular opening of approximately 5 to 6 millimeters in diameter is created with the cystotome by bending a 26-gauge or finer needle, or from various other customized styles. The entire procedure may be performed in a closed chamber with the cystotome entering the un-opened anterior chamber, or in a completely open or semi-closed chamber.[1] The irrigating cystotome, air bubble, or viscoelastic material may be used to maintain the anterior chamber depth. I prefer a viscoelastic material.

ADVANTAGES

1. This style of capsulotomy is easy to learn and is therefore practiced widely.
2. This can be performed on all types of cataracts including intumescent and hyper-mature cataracts.

DISADVANTAGES

1. Capsulotomy incisions leave multiple ragged edges, any of which could potentially promote catastrophic radial tears proceeding outwards towards the zonules.[2]
2. Surgical manipulations during phacoemulsification or MSICS of the nucleus may lead to unintentional tearing of the peripheral anterior capsular rim. These tears could

often extend to the capsular equator or even into the posterior capsule.

3. Posterior capsule tears may or may not be associated with vitreous loss and dropped nucleus fragments into the vitreous cavity.
4. The multiple ragged edges of the anterior capsule causes disturbance in aspiration of peripheral cortical residues.
5. Anterior capsular tears could result in de-centration of the intra ocular lens.

B. ENVELOPE (INTERCAPSULAR) CAPSULOTOMY

Sourdilla and Baikuff described the envelope capsulotomy technique in 1979 in France.[1] However Galand developed it to its present stage and popularized the 'Envelope Technique.[1,2]

Technique

A horizontal, slightly curved linear capsulotomy is aimed at the junction of the upper 1/3rd to middle section of the anterior capsule. This makes the superior flap slightly more mobile and gives a better access to the superior capsular fornix for the removal of cortical matter. Therefore, placement of the implant in the bag is easier.

Advantages

1. The preservation of the anterior capsule creates a semi-closed system within the anterior chamber and therefore, facilitates removal of cortical material.
2. The presence of the anterior capsule until the intraocular lens (IOL) is implanted reduces the chances of radial extension of tears
3. It facilitates the removal of the epithelial cells of the lens.

Disadvantages

1. It produces marked asymmetry of the capsular flaps. This predisposes to de-centration of the IOL. The IOL tends to sit upwards.

Capsulorhexis or Continuous Curvilinear Capsulotomy (CCC).

The capsulorhexis is also called continuous curvilinear capsulotomy (CCC). It was invented by Gimble and Neuhann simultaneously from different parts of the world.[1] This technique involves controlled shearing and tearing of the anterior capsule producing a strong, smooth, and regular circular opening.

Procedure

The anterior chamber is formed with viscoelastic, and a 26-gauge needle cystotome is advanced through the side port incision. The first puncture is made in the centre of the anterior capsule. The cystotome traverses to the left or right of the central slit to create a horizontal slit. The cystotome is placed underneath the slit in contact with the lens, and is lifted upwards towards the surgeon, so that a tear is produced and a small flap of anterior capsule is fashioned. This small anterior capsular flap is everted. The needle is placed near the junction of the flap and the peripheral anterior capsule. The needle pushes the flap along the tangent of that particular point along the imaginary circumference of the capsulorhexis opening. The flap is guided with push and pull motions in such a way that the correct size of circular opening is produced. The direction of flap rotation can be clockwise or counter clockwise according to the surgeon's preference. (Figure 1,2,3)

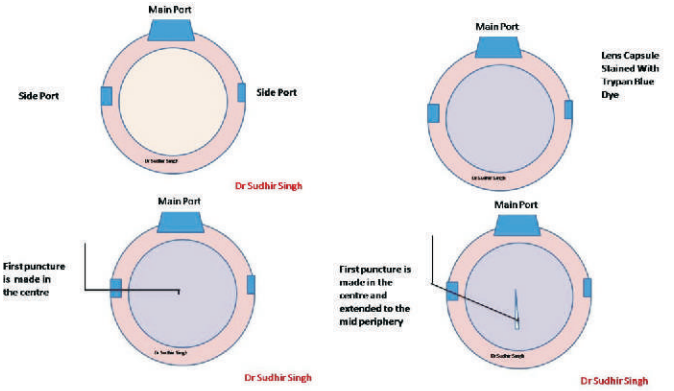

Figure 1 : Initiation of capsulorhexis

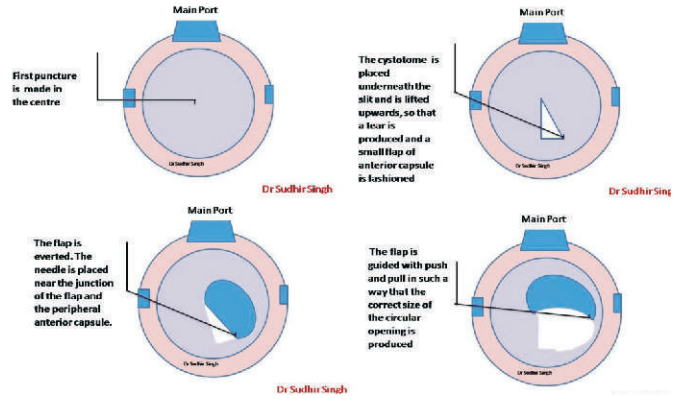

Figure 2 : Lifting of capsculorhexis flap in anticlockwise direction

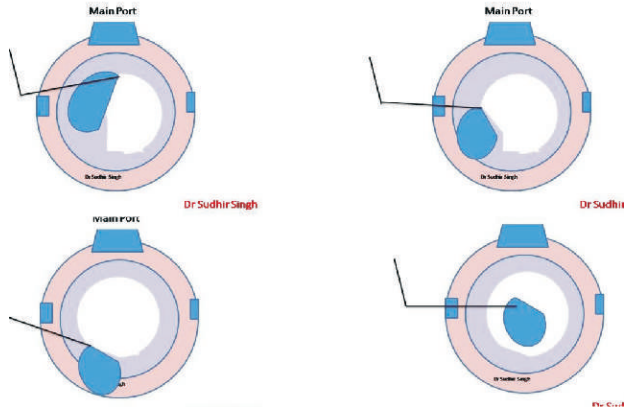

Figure 3 : Compleition of Capsulorhexis

Capsulorhexis Creation by Needle Cystotome Versus Forceps

Capsulorhexis is performed by both the needle cystotome as well as forceps equally well in expert hands. The cystotome can easily be advanced through the side ports while capsulorhexis forceps need to enter through the main incision. While maneuvering in the main port there may be more risk of anterior chamber collapse compared to performing this from the side port. Anterior chamber shallowing may cause peripheral extension or lost capsulorhexis. The capsulorhexis forceps are very useful in certain conditions like pediatric cataracts where the lens capsule is more elastic and in intumescent cataracts where intra-lenticular pressure is increased. However, it is important to maintain a deep anterior chamber with good viscoelastic materials.

Video https://youtu.be/z4S1JTc7sB4

ADVANTAGES

1. The capsulorhexis contributed significantly to the safety and effectiveness of cataract extraction and IOL implantation
2. It facilitates the size of a smooth, circular, capsular opening, and it produces a strong capsular rim that resists tearing even when stretched during lens material removal or lens implantation
3. The capsulorhexis facilitates procedures such as hydro-dissection, endo-lenticular phacoemulsification, capsular polishing, and safe lens implantation in both adults and children

DISADVANTAGES

Performing capsulorhexis requires some practice, experience and skill.

Capsulorhexis in difficult situations

It is extremely difficult to perform capsulorhexis in intumescent, mature and hyper mature cataracts, and cataracts in neonates and infants. With practice, however, it is possible to perform a small size capsulorhexis in these difficult situations. The use of forceps is desirable in bringing the peripheral extension of the capsulorhexis towards the centre.[3] However, it is important to maintain the anterior chamber with good viscoelastic substance, if forceps are being used for this technique.

Capsulorhexis in Intumescent White Cataract

Capsulorhexis in intumescent white cataract is done in three stages

Stage 1 Small Central Capsulorhexis: The anterior lens capsule is stained with trypan blue dye. The anterior chamber is filled with preferably cohesive viscoelastics in such cases. Initially a curvilinear tear to the anterior capsule is made and a capsular flap is folded. A small capsulorhexis is made by shearing and tearing forces using 26G needle cystotome from the side port incision.

Stage 2 Capsular Bag Debulking: This is done by aspirating cortical matter using the Simcoe irrigation/ aspiration cannula. .

Stage 3 Small capsulorhexis Enlargement: This is enlarged with the forceps after creating a curvilinear nick in the margin of the small capsulorhexis Although most cases can be dealt with using these techniques, if radial extension occurs, safe surgery can still be performed.

Video https://youtu.be/PJgueIL8qoQ

The 'Argentinian flag sign' is a peri-operative sign seen in patients with intumescent 'pearly white' mature cataracts during surgery. During capsulotomy a radial anterior capsular tear occurs through a trypan blue stained anterior lens capsules. After the tear has propagated equatorially what is left is a light blue torn anterior capsule with a central white cataract protruding from the capsule. Despite taking precautions, the 'Argentinian flag sign' is still encountered. It's not end of the world. The capsular tear can be converted to a 'can-opener' capsulotomy.

Video: Argentinean Flag Sign in a White Intumescent Cataract and Management https://youtu.be/DzwQrGcglcY

When this occurs, it can be successfully dealt with using simple techniques without compromising final visual outcome.

Large nuclear size and small capsulorhexis opening

If one plans to carry out MSICS with a small capsulorhexis along with a large nucleus, then two or three equidistant relaxing incisions are made at the capsulorhexis margins for safe prolapse of the nucleus into the anterior chamber. If one attempts to prolapse a large nucleus through a small capsulorhexis without making relaxing incisions, this can lead to zonular dialysis and rupture. If one plans to carry out phacoemulsification with a small capsulorhexis and a large nucleus then it is possible to proceed with phacoemulsification in the bag with special precaution not to damage the capsulorhexis margins.

Radial Extension of the Capsulorhexis Margins and Management

The predisposing factors for radial tears during capsulorhexis are: [3]

1. A shallow anterior chamber due to inadequate amount of viscoelastic or leaking of viscoelsatic from the ports.
2. High intra-lenticular pressure as seen in intumescent cataracts.
3. High positive vitreous pressure.
4. Weak zonules mostly associated with pseudo exfoliation syndrome
5. Pediatric cataracts, especially below 5 years of age have elastic anterior capsules.
6. A large capsulorhexis margin extending into the anterior zonular area causing disruption of the anterior zonules.

7. Inexperienced surgeons.

Rescuing Radial Tear Extension

When a radial tear starts to extend, inject more viscoelastic into the anterior chamber and try to pull the capsule flap towards the centre. If this step does not salvage the radial extension then start again from the opposite direction to complete the capsulorhexis. Despite all efforts, if a radial tear occurs then this is not the end of the world. Surgeons should take a deep breath for a few moments, keep calm and start again. The remaining part of the capsulorhexis can be completed by fine multiple incisions as seen in 'can-opener' capsulotomy. If phacoemulsification is planned, an experienced surgeon can complete the phacoemulsification with caution. If the radial tear is large and extending to the equator then it is wise to convert the procedure to MSICS.

Complications of the radial extension of the capsulorhexis

Radial extension of the capsulorhexis may lead to zonular dialysis, posterior capsular tears, vitreous prolapse, an unstable capsular bag and a dropped nucleus into the vitreous cavity during phacoemulsification.

Femtosecond Laser-Assisted Capsulotomy

Femtosecond laser-assisted capsulotomy is commonly known as femto capsulotomy. [4] The desired size and a round, regular and circular capsulotomy is made by this laser. These capsulotomies are more circular than manual capsulorhexis. Femto capsulotomy is useful in intumescent cataracts and fibrosed anterior capsule. Incomplete capsulotomies and anterior capsular tags are the main complications [5] of femto capsulotomies. Contraindications of femto capsulotomy are corneal media haze and a small pupil. The femtosecond laser machine is however very costly to install and this carries a very high cost of procedure. The comparison of manual capsulorhexis and femto capsulotomy is given below

Table 1 : Comparison between femtocataract surgery and Phaco surgery

Capsulotomy

	Femto Cataract Surgery	Phaco Surgery	Remark
Capsulotomy Type	Capsulotomy	Capsulorhexis	Functionally both are same
Circularity	More Circular	Less circular	•Non Significant if IOL is covered 360 degree by capsulotomy
Anterior Capsule tags	More	Less	
Non Dilated Pupils	Not Possible	Possible	With rings and hooks phaco is possible in abnormal pupils

Dr Sudhir Singh

Zepto Capsulotomy

The zepto capsulotomy is a new technique [6] employing novel technology for creating a circular capsulotomy. The zepto device and hand piece is an alternative to manual capsulorhexis that allows the capsulotomy alignment with the patient's visual axis for optimized intraocular lens placement and positioning. The hand piece is connected to a power console positioned away from the sterile field. The device is designed to produce round, accurately sized, centered capsulotomies during the surgical routine through the use of highly focused multi-pulse low-energy discharge across 360 degrees. This is useful in certain conditions like intumescent cataracts, pediatric cataracts and fibrosed anterior capsules. The zepto capsulotomy adds an extra cost to the procedure without substantial benefits.

Video: Manual Capsulorhexis in Difficult Cataracts Cases

https://youtu.be/Lo1s48qFKME

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Macular Hole

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ABSTRACT:

Since described as early has 1869 by Knapp, macular hole has been an entity of great interest for various investigators. This resulted in continuous revolutions in the underlying pathogenesis and its management. Recently OCT has emerged as most important imaging modality for prognostication and planning of surgical intervention. Most popular surgical intervention to treat macular hole is pars plana Vitrectomy with internal limiting membrane peeling with gas tamponade. This review article is focused on clinical features, pathogenesis, roles of newer imaging tools in the management of macular holes and different surgical approaches.

ABSTRACT:

Introduction

Macular Hole (MH) represents a partial or full thickness defect or dehiscence in the central retina at the umbo.[1] The prevalence rate of MH in India has been found to be 0.17%.[2] With the better understanding of pathogenesis and improvement in vitreoretinal surgical technique and instrumentation, excellent visual outcomes can be achieved.

Causes

Primary cause of MH in majority of cases is idiopathic. Trauma is among the most common secondary cause of macular hole. Apart from trauma, other conditions that can secondarily lead to MH are epiretinal membrane (ERM), cystoid macular edema (CME), retinal detachment(RD), proliferative diabetic retinopathy, severe hypertensive retinopathy, choroidal neovascular membrane (CNVM), juxta foveal telengiectasia, retinoschisis, lightening, photic retinopathy (electrocution, welding, accidental Nd-YAG laser).[3-6]

Clinical features

Idiopathic MH usually occurs in the sixth to seventh decade and women are affected more often than men; reported ratio is 2-3:1.[3] There is no proven theory for female preponderance but recently study done with SD-OCT has shown that females has significantly thinner central foveal thickness.[7] There is 3-29% risk of fellow eye getting affected with MH.[8]

Symptoms

Patients with smaller MH may have no symptoms and are diagnosed on routine ophthalmoscopic evaluation. Symptomatic patients usually complain of blurred vision and metamorphopsia. Those with larger holes will have scotoma or a defect in central vision.

Signs

Visual acuity of the affected eye may vary according to the size, duration, location and associated subretinal cuff of fluid. In smaller holes it may vary from 20/25-20/40 while in larger holes it may 20/80 to 20/400.

Amsler Grid is of great value in which the patient appreciates the bending/ waviness of lines and scotomas. On fundus examination, macular hole can be seen as well defined excavation at the macula and choroidal reflex can be seen through it. In some cases, few yellowish deposits can be seen at the base of the hole suggestive of lipofuscin-laden macrophages. Additionally, surrounding subretinal fluid can be appreciated, if present.

The Watzke- Allen test can be done on slit lamp and with direct ophthalmoscope. Herein, a thin narrow vertical beam of light is projected onto the macula and the patient is asked to perceive the light carefully and is asked to draw it on a paper. In a full thickness macular hole(FTMH), the line drawn is broken. Narrowing or thinning is suggestive of small MH, partial thickness MH or other differential diagnosis. A simple test using Maddox rod also reveals broken line suggestive of FTMH.

The laser aiming beam test is performed with 50-µm spot size laser-aiming beam. Test is considered positive when the patient fails to detect the aiming beam placed within the lesion but is able to detect it when placed onto normal retina. This test is useful in detection of small MH where Watzke-Allen sign is negative.

Investigations

Fundus fluorescein angiography (FFA)

FFA reveals transmitted fluorescence due to window defect at the area MH. FFA may also be helpful in prognostication; if done prior to surgery to look for the perfusion status of macula and anatomy of foveal avascular zone(FAZ).

Optical Coherence Tomography (OCT)

Only 28% of lamellar macular holes(LMH) diagnosed on OCT examination were detected clinically on fundus examination.[9] On the basis of changes noted on OCT, International Vitreomacular Traction Study Group proposed a new classification system of MH.[10](Table 1) This classification is of clinical importance because it determines the management and prognosis of macular holes. With the advent of ultra high resolution OCT, LMH has been described as any of the following (1) an irregular foveal contour; (2) a break in the inner fovea; (3) separation of the inner from the outer foveal retinal layers, leading to an intraretinal split; (4) absence of a full thickness foveal defect with intact photoreceptors posterior to the area of foveal dehiscence.[11]

Table 1: The International Vitreomacular Traction Study Classification System for Vitreomacular Adhesion, Traction, and Macular Hole

Vitreomacular adhesion	**Size: focal** (≤1500 μm) or broad (>1500 μm) **Isolated or concurrent**
VMT	Size: focal (≤1500 μm) or broad (>1500 μm) Isolated or concurrent
Full-thickness macular hole	Size: small (<250 μm), medium (>250μm and ≤ 400 μm), or large (>400 μm) Status of vitreous: with or without VMT Cause: primary or secondary

OCT based prognosis

Various parameters as measured by OCT: base diameter, defect depth, central foveal thickness and perifoveal thickness help to prognosticate the subtypes of LMH.

Hole form factor (HFF): It is defined as the ratio of the sum of the lengths of the two sides of macular hole to the base diameter. HFF between 0.9-1 has been correlated with better anatomical and functional outcome after surgery whereas HFF less than 0.5 is found to have poor prognosis.[12] (Figure 1)

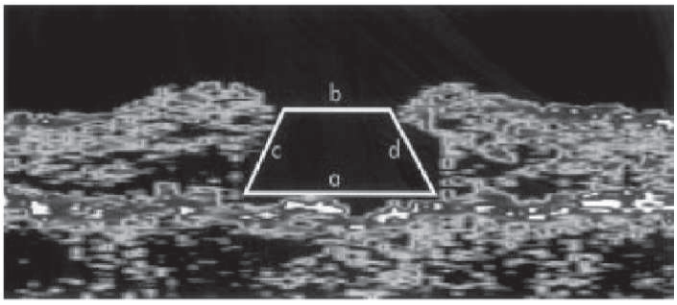

Figure 1: Hole form factor calculation for macular hole with raster OCT scan

It also delineates presence and type of ERM that can decrease success rates if not dealt during surgery. Intraretinal cystic spaces shown in OCT are also considered as good prognostic factor.

Fundus Autofluorescence (FAF)

Increased FAF signal at the base of MH has been attributed to the presence of melanolipofuscin (LF) or changes in the metabolic activity of the retinal pigment epithelium (RPE). Decreased FAF signal, suggesting the absent or degenerating RPE cells with reduced LF granule content.[13] Thus increased autofluorescence is a good prognostic factor.

Pathogenesis

The pathogenesis is incompletely understood.[14] A number of theories have been put forward to explain the pathogenesis.[15](Table 2)

Table 2: Various proposed theories for macular hole formation

Author	Year	Theory
Knapp	1869	Macular hole due to ocular trauma
Noyes	1871	Full thickness defect in retinal tissue du e to trauma
Fuchs & Coats	1901,1907	Cystoid degeneration
Lister	1924	Antero-posterior traction
Morgan & Schatz	1986	Involutional thinning and vascular theory
Gass	1995	Tangential traction forces
Tornambe	2003	Hydration theory

The major milestone in understanding of pathogenesis of MH was classification by Gass.[1] Green proposed that chronic low-grade traction due to ocular rotation stimulates cellular proliferation of Muller cells, astrocytes and RPE realigning vitreous fibres and redirecting the tractional force in tangential direction.[16]

Studies done with OCT has showed that the initial stage of MH formation starts as a triangular elevation of outer photoreceptor layer(OPL) and its detachment from RPE due to tractional forces. The traction on the fovea occurring prior to anatomic changes to the fovea has been referred to as Stage 0 and may resolve without progression in 40-50% of patients.[17] Ezra published an OCT documented study suggesting that failure of normal age-related separation of cortical vitreous from posterior pole as a result of an abnormally tenacious attachment to the fovea leads to MH formation.[18]

Differential diagnosis

The varied presentation of lamellar macular defect may mimic a MH. Lamellar macular defects were categorised into three different subtypes based on their OCT appearance: LMH, macular pseudoholes (MPH), and foveal pseudocysts (FP).[19]

Lamellar holes have thin fovea resulting from avulsion of inner layer of macula.

A macular pseudohole results from the centripetal

contraction of an ERM that subsequently leads to verticalisation of the foveal slopes and a sharply punched out defect.[20]

FP is described as a precursor to MH or LMH formation due to direct vitreomacular traction(VMT).[9] ERM can also result in avulsion forces leading to the formation of pseudocyst.[21]

It has been found that MPH have smaller diameter and thicker central foveal tissue, therefore they have better visual acuity than LMH and FP whereas both LMH and FP are shown to have deeper and wider intraretinal split and also thin central foveal tissue.[19]

Management

FTMH were once considered untreatable and surgery was indicated once extensive RD occurred.[22,23] In 1991, Kelly and Wendel first demonstrated a surgical procedure to close idiopathic MH with good functional outcome.[24] Later several adjuncts like TGF-β, autologous platelet concentrate, bovine thrombus, laser barrage etc.[25,26]

Currently indications of surgery are as follows;

A. On the basis of macular hole staging and pre-op visual acuity
   1. FTMH with stage II and above
   2. Patients with stage III and IV with visual acuity of 6/18 or below: these patients readily gain 2 or more line improvement after surgery.
3. Stage II macular holes with visual acuity ranges from 6/12 to 6/18 (20/40 -20/60).
4. Patients with visual acuity of > 6/12 presenting with minimum symptoms like metamorphopsia and smaller hole size rarely requires surgery. Freeman et al observed spontaneous regression in 4% of all cases. Therefore, these patients can be followed up.[27]

B. As per Imaging modalities

OCT based parameters and FAF are important to prognosticate and to plan the surgery

Surgical objective of macular hole surgery

Surgical objective of MH surgery is twofold; first to relieve tractional forces; second to activate reparative healing mechanism.[28,29]

Surgical Technique

Pars Plana Vitrectomy with internal limiting membrane (ILM) peel with fluid gas exchange (FGE) is the accepted technique. Earlier, 20G system and currently 27G, 25G and 23G systems have been employed.[30] Brilliant blue G(BBG) dye is used at concentration of 0.25mg/ml for staining ILM. This dye does not stain ERM thus after removal of ERM, dye should be re-injected to look for residual ILM. This method is called as double staining and ensure complete removal of ILM.[31] Lifting of ILM has been a challenge as well as traumatic to retina.[32] Newer instruments like silicone tipped cannula, diamond duster and finesse flex loop have made ILM peeling convenient and less traumatic.

Recently many techniques have been proposed for large and refractory MH; fovea sparing ILM, free flap, inverted ILM flap with and without PFCL, cabbage technique.[33-37] All these techniques aim at stuffing macular hole with ILM. This is postulated that this ILM will serve as scaffold for retinal tissue to grow upon. There are various reports that these flaps get dislocated with fluid current and during fluid air exchange. Autologous retinal transplant has also been used to plug macular hole also provides scaffold and plugs macular hole.[38]

To peel or not to peel:

Studies favouring ILM peeling state that peeling removes the template upon which the glial cells proliferate. Also, it removes the tangential traction. ILM peeling serves to increase MH edge mobility and reduce MH diameter.[29]

Studies which do not advocate ILM peeling postulated that removal of ILM injures the muller cell footplates and trigger reparative gliosis.[32]

ILM peeling has shown higher rate (92%) of primary closure of MH as compared with eyes undergoing MH repair without ILM peeling (82%). Late reopening of hole was also found to be higher in no ILM peeling group when compared with ILM peeling group (7% vs 0.6 %).[39]

To posture or not to posture is still a controversial issue. Studies have reported strict face down posturing(FDP) for at least a week (24). It is thought to aid hole closure due to the buoyant force of intraocular gas bubble.[40] The gas bubble keeps the edges of macular hole dry and provides scaffold for glial cell proliferation.[38,41] Also surface tension is constant around the bubble's interface with the retina as long as volume of gas is 2/3 rd to 3/4th of vitreous cavity.[42]

But successful hole closure without FDP as reported in Tornamby Pilot study supports the approach avoiding FDP.[43] Various other studies favoured no FDP or a minimum of one day FDP and showed 90% anatomical and functional success rate.[44,45]

Endotamponading agents

In original description of macular hole surgery, use of non- expansible gas of SF6 with 1 week FDP was indicated.[23] In patients who require long-term tamponade, cannot maintain positioning or have to travel by air, silicone oil can be opted. But its removal requires another surgery and also anatomical closure is found to be only 65% as compared with C3F8 gas

which has 91% success rate.46 C3F8 and densiron 68 share advantage of having longer effect and both do not require positioning. Densiron-68 is a mixture of silicone oil and amphiphilic perflurohexyloctane, which facilitates better contact with the retina compared with standard silicone oil.[47] Vitrectomy and air tamponade combined with 1- to 3-day facedown positioning produced an excellent rate of macular hole closure.[42,48]

Types of macular hole closure

On the basis of postoperative OCT findings, closed macular holes have been classified into two groups:

Type 1: MH is closed without foveal defect of the neurosensory retina

Type 2: Foveal defect of the neurosensory retina persists postoperatively although the whole rim of the MH is attached to the underlying RPE with flattening of the cuff.[49]

Complications of surgery:

1. Swelling of the arcuate retinal nerve fiber layer (SANFL): The SANFL does not appear to impact the final BCVA and can be expected to disappear in about 3 months.[50] There are two hypotheses regarding the cause of SANFL.[51] The first hypothesis is that surgical forceps cause direct damage to the retina when grasping the ILM while the second is that ILM peeling causes damage to the Müller cell endplates that are attached to the ILM.[51]
2. Dissociated optic nerve fiber layer (DONFL), which is similar to the SANFL is observed as small, spindle-shaped splitting adjacent nerve fiber bundles on SDOCT.[52] Not all patients who undergo ILM peeling will present with the DONFL postoperatively,and there have been no significant differences observed between eyes with and those without the DONFL with respect to BCVA or macular sensitivity. The reason for DONFL presentation is also unclear, although some authors speculated that the DONFL is caused by irregularly distributed Müller cells following ILM peeling in regions that show a higher density of nerve fiber bundles in the RNFL.
3. Retinal breaks:The incidence of retinal break formation during macular hole surgery is 5.5%.[53]
4. Retinal detachment
5. Gas cataract: The cataract progression following macular hole surgery is found to be 64% within first year. Therefore these days it is advocated to undergo combined macular hole and cataract surgery. Lens extraction also allows a more complete Vitrectomy.[54]

Conclusion

Macular hole can be caused by several factors. Not all macular holes need surgical intervention. OCT has redefined the macular hole and its prognostication. Also with the invention of MIVS, surgical techniques and functional outcomes has been improved dramatically.

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Correlation Between The Pressure-to-Cornea Index And Both Structural And Functional Measures Of Primary Open Angle Glaucoma In North Indian Population In And Around Lucknow

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ABSTRACT:

Background: Glaucoma is a potentially blinding disease known as "Sneak thief of Sight". It is the second leading cause of visual loss worldwide. Thus, making the recognition of all risk factors of utmost important. Early detection and diagnosis is essential so that treatment can delay disease progression. Intraocular pressure and Central corneal thickness are known risk factors for the progression of glaucoma.

Design: The following study is a prospective co-relational hospital based study.

Setting: Department of Ophthalmology, Vivekananda Polyclinic and Institute of Medical Sciences, Lucknow.

Methodology: 26 cases aged >40 years – 42 cases each with primary open angle glaucoma, ocular hypertension and those without POAG and ocular hypertension were enrolled. Demographic details of patients were noted, all the patients underwent detailed ocular examination, including assessment of visual acuity, intraocular pressure, optic disc status, central corneal thickness by pachymetry and visual field evaluation by Humphrey's perimetry. Corrected intraocular pressure adjusted for central corneal thickness and pressure to cornea index (PCI) values were calculated.

Results: Pressure-to-cornea index values ranged from 74.03 to 450.21 with an overall mean value of 153.96+59.40. Group I (210.64+63.53) followed by Group II (150.13+19.09) and Group III (101.12+13.74) respectively. All the between group differences were significant ($p<0.001$).

Conclusion: Evaluation of pressure-to-cornea index showed a significant difference with progressive increase from controls to OHT and finally culminating in POAG group. PCI had a highly efficient discriminant value too. PCI could be used as a sensitive indicator to evaluate progression of glaucoma and early glaucomatous changes.

Keywords: Glaucoma, intraocular pressure, central corneal thickness, pressure-to-cornea index

Introduction

Glaucoma is a potentially blinding disease that affects 66 million persons worldwide [1]. It is the second leading cause of visual loss in the world. With an expected increase in population and longevity, primary open angle glaucoma (POAG) is likely to become a major cause of ocular morbidity in the developing world. It is a multifactorial optic neuropathy in which there is characteristic atrophy of the optic nerve. The disease is characterized by typical changes in the optic nerve with associated visual field defects. In open-angle glaucoma, by definition, the anterior chamber angle is open by gonioscopic appearance. In this thesis, primary open-angle glaucoma is referred to as glaucoma. The etiology of POAG remains unclear despite a number of epidemiological studies that have investigated various potential risk factors for the disease.

Recognition of all risk factors for POAG is important for early diagnosis and intervention. It manifests mainly as peripheral visual field loss with central vision being preserved almost till the end stage. By the time the patient is symptomatic the visual loss is irreversible. Therefore, early diagnosis is essential so that treatment to halt progression can be instituted.

POAG is a neurodegenerative condition that is multifactorial in origin and numerous potential risk factors for development of the disease, in addition to intraocular pressure (IOP), have been identified [2]. An association between IOP and central corneal thickness has also been enumerated in a number of studies [3]. Central corneal thickness has recently been recognized as a significant risk factor for progression of ocular hypertension to primary open angle glaucoma (POAG). However, whether central corneal thickness can be taken as an independent predictor for development and progression of POAG often remains debatable owing to the fact that measurement of corneal thickness is affected by central corneal thickness. A reduced corneal thickness of 0.45mm could produce an underestimation of the IOP by up to 4.7mmHg, whereas an increased CCT of 0.59mm could cause an overestimation of 5.2mmHg when the actual IOP was 20mmHg. [4]

Considering this need, the present study was aimed to integrate intraocular pressure and central corneal thickness as a single risk factor for early detection and estimation of disease severity of primary open angle glaucoma at a tertiary care centre in Northern India.

METHODOLOGY

The proposed study was conducted over a span of one year, from May 2016 to April 2017 on a sample population attending ophthalmic clinic at Vivekananda Polyclinic and Institute of Medical Sciences, Lucknow which is a tertiary care referral centre and one of the largest hospital outside government sector in Lucknow. The sample size was calculated using the following formula Charan and Biswas (2013) [i]:

$n = 2(Z_{\alpha/2}+Z_{\beta})^2 SD^2/d^2$

where, n: Sample size per group

SD: Pooled standard deviation

d: Difference in the means (effect size)

$Z_{\alpha/2}$: critical value of z at 95% confidence

Z_{β}: critical value of z at 80% power

A total of 126 patients were included in the study and divided into three groups of 42 patients each. Group I included patints with confirmed diagnosis of primary open angle glaucoma, Group II included patients with ocular hypertension and Group III were normal healthy controls.After explaining the procedures, all subjects were asked to sign an informed consent and undergo a complete eye examination with evaluation of the visual acuity, anterior segment biomicroscopy, tonometry with the Goldmann tonometer, gonioscopy with a two mirror gonioprism, and optic disc assessment with 90 D Volk lens on a tropicamide dilated pupil. The IOP was measured after discontinuation of all glaucoma medications for at least 21 days. Standard automated perimetry (SITA standard 30-2) was done with the Humphrey Field Analyzer 730 with appropriate refractive correction. CCT was measured with ultrasonic pachymeter, and three measurements were averaged to obtain one single value.Data was analyzed using Statistical Package for Social Sciences (SPSS) version 21.0.

RESULTS

Age of cases ranged from 42 to 75 years with a mean age of 56.71±6.79 years with majority of patients in age group 51 to 60 years. Overall as well as in all the three groups, majority of cases were males. Though proportion of males was higher in Group II (69%) as compared to that in Groups I and III (54.8% and 52.4% respectively) yet this difference among groups was not significant statistically (p=0.245).

DISCUSSION

As glaucomatous visual field (VF) damage is irreversible, early detection of impairment is essential to attempt to reduce or halt VF progression by controlling intraocular pressure. Moreover, sometimes it is difficult to determine early glaucomatous changes. Often it has been proposed that functional and structural combination could define the risk of glaucoma and could also help in determining the extent of visual field damage in more objective terms.

Table 1: Intraocular Pressure, Central Corneal Thickness and Corrected Intraocular Pressure Evaluation

SN	Findings	Group I (n=42)	Group II (n=42)	Group III (n=42)	Statistical Significance
1.	Mean uncorrected IOP (mmHg)	23.95±6.31	23.33 ±2.68	15.95±2.23	F=48.02p<0.001
2.	Mean CCT (µm)	504.38±22.08	540.62±21.71	542.93±15.77	F=48.77p<0.001
3.	Mean Corrected IOP (mmHg)	26.57±6.32	23.55 ±1.77	16.12±1.78	F=78.86p<0.001

Table 2: Intergroup comparison of Pressure-to-Corneal Index

Group	No. of cases	Mean	Minimum	Maximum
I	42	210.64	120.87	450.21
II	42	150.13	122.63	191.65
III	42	101.12	74.03	133.33
Total	126	153.96	74.03	450.21

F=82.635; p<0.001

It was in the year 2007, when Iliev made an attempt to unify central corneal thickness and intraocular pressure as a unified risk factor as a new glaucoma index.[6] Though, theoretically upright and showing potential in that assessment, this index is still not been validated in different environments. In present study, we made an attempt to evaluate its usefulness for early detection and estimation of disease severity of primary open angle glaucoma at a tertiary care centre in Northern India.

In present study, a significant difference in corrected IOP was observed in all the three groups. The corrected IOP values showed a decreasing trend from POAG to OHT and control group. Thinner CCT showed a significant association with POAG which is similar to the study done by Moghimiet al. (2014)[7] who found that CCT of glaucomatous eyes to be significantly thinner as compared to non-glaucomatous eyes and is a powerful predictor for the development of POAG.

Evaluation of pressure-to-cornea index showed a statistically significant difference among different study groups, showing a progressive order from controls to OHT and finally culminating in POAG group. PCI had a highly efficient discriminant value too. It was observed that for all the between group comparisons the differences were significant statistically. These findings are in consonance with the observations made by Ilievet al. (2007)[6] who also found that mean PCI values showed a significant incremental trend starting from controls, OHT and POAG respectively.

CONCLUSION

It can be concluded that pressure-to-cornea index was a useful discriminating indicator to differentiate between POAG, ocular hypertension and healthy controls. PCI values also showed a good correlation with structural and functional parameters and severity of glaucoma.

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Effect Of Arcus Senilis On Intraocular Lens Power Calculation With Intraoperative Aberrometry

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ABSTRACT:

Setting: Brimhall Eye, Las Vegas, Nevada, USA

Design: CASE REPORT

Purpose: We report a case of arcus senilis affecting the accuracy of intraocular lens (IOL) power calculation using intraoperative aberrometry.

Methods: The Optiwave Refractive Analysis device (Alcon Laboratories, Inc.) requires the user to input optical biometric measurements such as axial length (AL), keratometry (K) values, lens thickness, anterior chamber depth, and white-to-white (WTW) diameter.There was a large difference in the predicted IOL power (+1.50 diopters) between the IOL power calculation using preoperative optical biometry and intraoperative IOL power calculation using intraoperative aberrometry (Optiwave Refractive Analysis). After the arcus senilis was adjusted for, by manually measuring the white-to-white distance intraoperatively and that new value was entered into the intraoperative aberrometer, the measurement matched the preoperative measurements and confirmed the correct choice of IOL.

Conclusion: We hypothesized that the intraoperative aberrometer predicted a much lower target IOL power because of the smaller WTW. After the WTW intraoperatively measured with calipers was inputted into the intraoperative aberrometer, the aberrometer's IOL power prediction aligned with that of the Barrett Universal II formula,confirming our hypothesis. Thus, it is imperative to review all preoperative measurements for symmetry between fellow eyes and identify any outliers because these might cause unexpected predicted IOL powers during surgery.