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Dear seniors & friends

It is time to start another year of academics of DOS; to take a fresh look at all activities, to further modify existing portals for reaching higher goals; to enhance so that we can excel.

This first issue of DOS TIMES 2016 – 2017 is yet again devoted to its commitment of bringing to you another edition of excellent academic topics of current interest to your desktops. We have here an exciting compilation of contributions from renowned authors across the country and a treat to read through their ophthalmic experiences. All regular features of DOS TIMES are feature as always.

This issue also holds together all information about DOS activities for the current year. Please do take note of dates of all DOS monthly clinical meetings 2016 – 2017. The DOS academic calendar promises this year’s academic feast in form of our winter DOS 2016 in November 12 – 13, 2016 and DOSCON 2017 in April 7 – 9, 2017 waiting to be grand events as never before. The third edition of iDOS (international DOS), a joint DOS – COSL event with the ophthalmologists of Srilanka, to be held in Taj Samudra, Colombo, December 22 – 24, 2016, promises to be an exciting mix of academics and leisure in the tropical setting with an enjoyable CHRISTMAS in COLOMBO. As we look forward to incorporate new approaches in DOST (DOS Teaching) 2017, and our DESK (DOS Enhanced subspecialty Korner) programs, may I request for a heightened participation and patronage to all DOS activities. We hope to also set the road for the unfolding for the DOS – WSPS 2017 event.

DOS has proven time and again to be the society to be looked up to and let us vow to take it further to heights as never before with the untiring efforts of our executive. I wish to conclude with sincere thanks to our president Dr Rishi Mohan, our past president Dr Cyrus Shroff, treasurer Dr Vipul Nayar and the entire executive and the support extended by all ophthalmic institutions towards the enormous success of DOS for the year 2015 – 2016.

It is time for yet another fresh start to propel DOS further into 2016 – 2017, to make a GRAND NEW ENDING......

For last year’s words belong to last year’s language
And the next year’s words await another voice
And to make an end is to make a beginning

- T S Elliot

With best regards.

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Respected Seniors and Dear Colleagues,

Greetings from the DOS Executive!

It gives me great pleasure to write this Special Message in the First issue of the DOS Times for the Academic Year 2016-17.

My Congratulations go out to the Secretary, Dr. Vanathi, Treasurer, Dr. Vipul Nayar and the entire Executive for the past year, full of accomplishments and the successful conduct of the DOS Conferences and programmes, the fruitful conclusion of which has enthused the entire Executive for the coming year.

Thanks are due to our immediate Past-President, Dr. Cyrus Shroff, for guiding the Society activities and honing the Executive Committee into an efficient and cohesive machine.

As we embark on the proceedings this year, there are specific areas that we need to focus. The Monthly Meetings of the DOS make it the singular, stand-out feature of the scientific undertakings of our august Society. I’m happy that the re-appraisal of the Monthly Meetings has already been done by the Sub Committee and measures suggested to improve the scientific deliberations as well as the mechanisms to select the Centres hosting the Meetings. These recommendations shall be implemented in the current academic Year.

Already, some exploratory work has been done on the DOS House with a few options being studied. The Academic, Research and Fellowship Sub Committee would have deliberated by the time this issue reaches the Members and I’m in no doubt that some positive objectives will emerge.

As you all are aware, the DOS is the host to the World Society of Paediatric Ophthalmology and Strabismus for the 4th World Congress (WCPOS) scheduled in Delhi in December 2017. An area of concern is that we have not been able to finalize the Memorandum of Understanding with the WSPOS, owing to some objections by certain of our senior office-bearers. I hope that we are able to satisfy these concerns soon, so that the DOS doesn’t lose this golden opportunity to be the 1st State Society to host a World Congress.

I am excited that all the preparations for the iDOS-COSL Meeting in Colombo, SriLanka from December 22-24, 2016 are well on track. Details and Online registrations shall be open on www.iDOS.co.in and I urge all Members to join us on this wonderful academic and fun-filled international programme!

The Scientific programme and agenda, dates and venues for the Year 2016-17 are highlighted in the Secretary’s editorial.

At the end, I wish to say that all efforts are being made by the Office and the Executive for a high quality scholastic programme, to ensure an action packed year and help safeguard the numero uno position that the DOS maintains amongst the state ophthalmic societies of the country.

With Warm Regards,

Dr. Rishi Mohan
President, DOS &
Director, MM Eyetech Institute of Ophthalmology, Lajpat Nagar-3, New Delhi.

Dr. Rishi Mohan
Endophthalmitis is one of the most dreaded complications of any intraocular procedure causing severe ocular morbidity and vision loss. Endophthalmitis is defined as an inflammation of internal layers of the eye, resulting from intraocular colonization of infectious agents and manifesting with an exudation into the vitreous cavity.

Endophthalmitis is one of the most dreaded complication of any intraocular procedure causing severe ocular morbidity and vision loss. Endophthalmitis is defined as an inflammation of internal layers of the eye, resulting from intraocular colonization of infectious agents and manifesting with an exudation into the vitreous cavity.

Etiologically, endophthalmitis can be broadly divided into exogenous and endogenous endophthalmitis (Flowchart 1).

**POST-INTRAVITREAL INJECTION ENDOPHTHALMITIS - WHY IS IT IMPORTANT?**

The incidence of post-cataract endophthalmitis ranges between 0.09% - 0.33% in various studies1. The incidence of suspected endophthalmitis post-injection has been reported to be around 0.038% and varies from 0.021% - 0.045%2,3.

Although, the incidence is low, with dramatic increase in the number of injections performed annually especially in India, post-injection endophthalmitis is a matter of grave concern as this is the most commonly performed medical procedure (about twice the cataract surgery) and there are confirmed reports of series of cluster endophthalmitis from our country4,5,6. Cluster endophthalmitis being defined as 5 or more cases occurring on a single surgical day and the same operating room at the centre involved. Since multiple patients undergo the procedure in one sitting, any breach in asepsis, cold-chain or other factors may leads to increased risk of cluster endophthalmitis. One of the major reasons of rise in post-intravitreal injection endophthalmitis is procurement of counterfeit drugs and improper storage of drug/lapse in cold chain when the same vial is used more than once. This is especially true for Bevacizumab which is being used multiple times.

**CHARACTERISTICS OF POST-INTRAVITREAL ENDOPHTHALMITIS AS COMPARED WITH POST-SURGICAL (CATARACT) ENDOPHTHALMITIS (POE VS PIE)**

Post-surgical endophthalmitis (POE) may present either as fulminant (<4 days), acute (5-7 days) or chronic form (>4 weeks). The most common symptom in both types of endophthalmitis is vision loss. The most frequent pathogens reported in post-intravitreal endophthalmitis are gram-positive bacteria (91.3%), including coagulase-negative staphylococcus (78.3%). However, predominant pathogen in post-surgical endophthalmitis is gram positive organism, especially staphylococcus epidermides.

- Though the incidence of post-intravitreal endophthalmitis (PIE) is low as per western figures, actually the risk is high, it is the most commonly performed medical procedure and there has been a dramatic increase in the number of injections performed annually.
- Also multiple patients injected in one OT increases risk of cluster endophthalmitis in PIE.
- The time period for occurrence of PIE from injection to presentation is early and ranges from within 24 hrs. to even upto 26 days as reported, with average of 4 days.

There has been some reports of culture-negative sterile endophthalmitis after intravitreal bevacizumab injection for different retinal pathologies, resembling toxic anterior segment syndrome (TASS-like) seen after intraocular surgery11-13. A case series of such patients presenting with sterile endophthalmitis following intravitreal injection and successful treatment

**Flowchart 1: Classification of Endophthalmitis**

- Exogenous
  - Post-operative (includes Post-cataract surgery endophthalmitis, Post-intravitreal injection endophthalmitis)
  - Post-traumatic
  - Perforated corneal ulcer etc.

- Endogenous / Metastatic
  - Hematogenous dissemination

- Post-intravitreal injection endophthalmitis (PIE) - Comparative evaluation with post-operative endophthalmitis (POE)

Raghav Ravani, Atul Kumar
with intravitreal antibiotics along with topical antibiotics and steroids has been reported from our centre, highlighting the possibility of sterile endophthalmitis following intravitreal injection of bevacizumab and its management. However, Streptococcus viridans, a component of human oral flora has been reported to be present three times more often in post-injection endophthalmitis as compared to postsurgical endophthalmitis.

Thus, post-injection endophthalmitis (PIE) has early presentation and worse prognosis (Figure 1), especially with streptococcus viridans. The incidence is especially more in office-based setting as compared to the operating-room setting.

PEARLS ON - MYTHS AND FACTS IN CAUSATION OF POST-INJECTION ENDOPTHALMITIS

Indication based risk factor

The risk of endophthalmitis seems to be lower in eyes with macular edema secondary to retinal vein occlusion as the indication for injection. The risk is more in patients with diabetic eye disease and neovascular age-related macular degeneration (AMD), with impaired or waning immunity as the hypothesized mechanism in both.

AGENT AND TECHNIQUE

The incidence of post-intravitreal endophthalmitis does not however depend upon the type of anti-VEGF agent used, the hemisphere of injection or conjunctival displacement during the procedure.

PROPHYLACTIC TOPICAL ANTIBIOTICS

The studies on role of topical antibiotics in prevention of post-intravitreal injection endophthalmitis concluded lack of evidence to support pre, peri or post-injection topical antibiotics. Thus, post injection topical antibiotics, does not reduce the risk, infact one of the studies showed trend towards higher incidence. However, short course of post-procedure prophylactic antibiotic is used on surgeon’s personal experience and discretion.

PEARLS ON - PRECAUTIONS FOR PREVENTION OF POST-INTRAVITREAL ENDOPTHALMITIS

Pre-operative preparation and precautions

Patient screening & precautions:
- The need and choice of intravitreal injection should be tailored to the individual patient as required in the best clinical judgment of the attending/injecting physician.
- All patients should be screened to ensure patent nasolacrimal duct and negative regurgitation test.
- Patients with active infection of the ocular adnexa (blepharitis, meibomitis), or a blocked nasolacrimal duct/positive regurgitation test are at high risk for endophthalmitis and should not be treated for the active infection first. Injection should be postponed until the active infection is cleared.

Surgical/Procedural time-out to verify patient’s name, intravitreal agent and laterality should be practiced before injection in each patient.

Bilateral injections is NOT recommended and injection in the other eye should be spaced at least one to two weeks apart.

Patients with uncontrolled systemic condition like uncontrolled diabetes and hypertension should first be treated for it.

Preparation of single dose Avastin anti-VEGF ampoules involves use of air curtains to enter the Class 10 facility where they are prepared within a Laminar Hood, as is done in Dr. R.P Centre (above) (Figure 2).

PATIENT PREPARATION

- A written-informed consent should be taken from all patients, explaining the procedure and the risks involved.
- Off label use of Bevacizumab to be included in consent and explained to the patient.
- Each patient to be given clean OT gown, protective cap and booties before entering the preoperative holding area/operating room.
- In the preoperative holding area / or on table, the periocular skin should be cleaned with povidone-iodine 10% solution.

Dr. Rajendra Prasad Centre for Ophthalmic Sciences, AIIMS, New Delhi

Dr. Raghav Ravani MD

Dr. Atul Kumar MD, FAMS
STERILIZATION OF OPERATING ROOM AND OPERATING ROOM MILIEU

- **Location:** Intravitreal injection should be administered in the operating-room setting, and NOT in office-setting.
- **Fumigation:** should be done daily with 20% v/v of solution containing stabilized hydrogen peroxide 11% w/v and 0.01% w/v diluted silver nitrate solution, using 1lit/1000 cu-ft with aerial fumigation for 60 min.
- **Culture:** Blood agar culture plates should be placed for around 30 min in operating room and sent for microbiological culture, the reports of which are to be checked prior to starting the intravitreal procedures.
- **Floors:** The operating room should be mopped on the night before surgical camp with 10% v/v of similar solution as described above.
- **Walls:** The wet surface of walls, trolleys, operation tables and floors should be sprayed on each day 60-90 minutes prior to starting of the procedure with 2% solution containing chemically bound formaldehyde and glutaraldehyde.
- **On the day before the injections,** the surgical instruments & required linen should be autoclaved following the standard protocol.

Intra-operative precautions

**Surgeon factors**

- Surgeon should wear washed OT clothes, OT slippers, cap and mask.
- Surgeon should perform 3 scrubs with a solution equivalent to 4% w/v of chlorhexidine gluconate for at least 5-7 min under running water as per WHO recommendation.
- Gloves to be changed before injecting each patient.
- The surgeon/staff/patient should minimize speaking on table during preparation or during the injection procedure to minimize spread of aerosolized droplets containing oral contaminants.

**Peri-injection precautions**

- **Location:** The procedure should be performed in an operating-room setting and not in office-setting.
- **Cleaning and draping:** Use 10% povidone iodine to clean skin and ocular adnexa, 5% povidone iodine for instillation into cul de sac with contact time of at least 3 minutes (Figure 3).
- **Surgical area should be draped using sterile linen and a separate plastic eye-drape for each patient to isolate the field.**
- A speculum should be used to prevent contact of the eyelashes and eyelid margins with injection site and the needle.
- Topical anesthetic drops should be preferred over anesthetic gel as the latter may interfere with povidone-iodine contact with the conjunctiva / injection site.

- Reapply povidone-iodine after anesthetic drop use. Before injection, povidone-iodine (5%) should be the last agent applied to the intended injection site.
- Routine anterior chamber paracentesis NOT recommended.

Post-operative precautions

- **Proper lid hygiene should be maintained in the post-op period.**
- **Post-injection topical antibiotics does NOT reduce the risk of infection/endophthalmitis.**
- **Post-injection IOP should be monitored and topical antiglaucoma may be prescribed for post-injection IOP spike as and when warranted.**
- **All patients should be given a discharge card mentioning the injection details, postoperative instructions, symptoms of infection (pain, redness, dimness of vision, swelling, discharge etc.) and 24-hour emergency contact information.**
- **After each day, all the instruments and linen after thorough cleaning and drying should be autoclaved for the next day.**
- **Follow-up of each patients should be tailored as per the indication for the intravitreal injections.**
- **Intravitreal injection of Bevacizumab (Avastin©) for ophthalmic disorders may be considered at treating physician's discretion, under strict aseptic precautions and following the recommended guidelines after informed consent of the patient.**

Intravitreal injection of medications for various posterior segment disorders has become one of the commonest procedure performed worldwide. With extensive ongoing trials worldwide for various disorders involving intravitreal injection of different pharmacological agents, intravitreal injections have become a standard protocol and mainstay treatment for various pharmacological disorders. Endophthalmitis following intravitreal injection, though rare, is a dreaded complication causing significant ocular morbidity and vision loss. Following standard surgical procedures, precautions and maintaining asepsis can go a long way in preventing this complication and provide better outcomes.

TREATMENT OF POST-INJECTION VERSUS POST-SURGICAL ENDOPHTHALMITIS CONFIRMATION OF DIAGNOSIS

As mentioned earlier, patients receiving intravitreal injection of bevacizumab may present with sterile
endophthalmitis. In cases of doubt, it is important to consider all unexpected inflammatory response following injection or surgery to be endophthalmitis unless proven otherwise. The diagnosis can be confirmed by culture of causative organism in-vitro from intraocular samples. Samples that can be collected are aqueous tap or vitreous sample (higher yield) or both (preferred). Vitreous sample can be obtained by vitreous tap using 23-G needle through pars plana route before intravitreal antibiotic injections. However, due to inadequacy of sample for analysis and theoretical risk of producing vitreous traction during aspiration, vitreous biopsy is preferred by many surgeons especially without infusion line to safely obtain adequate volume of sample that provides higher yield of organisms. This may be performed as a sole procedure or just before pars plana vitrectomy for endophthalmitis. The sample is then sent for staining for microscopic evaluation and culture & sensitivity. Apart from confirmation of diagnosis in patients presenting with intraocular inflammation, it is also important to maintain and check records of the batch number of the drug used, and patients receiving injection on same day or injection from the same batch number. Thus helping to trace the source of infection and early detection of other cases of endophthalmitis in the cluster if any.

- Treatment in post-surgical endophthalmitis can be initiated following EVS (Endophthalmitis Vitrectomy Study) guidelines. This includes anti-bacterial therapy in form of intravitreal antibiotics, anti-inflammatory therapy, supportive therapy or surgery. Concentrated topical antibiotics should be considered empirically till the culture results are awaited, especially if route of infection spread seems to be from anterior segment. Concentrated topical antibiotics may include ceftazolin 5% and tobramycin 1.3%. Commonly used empiric intravitreal antibiotics include vancomycin 1mg/0.1ml and ceftazidime 2.25 mg/0.1 ml. Though, EVS concluded no additional benefits of parental antibiotics in post-cataract surgery endophthalmitis, parental antibiotics help in augmenting and sustaining an adequate concentration of antibiotics in the vitreous cavity for a more prolonged period. Also, with use of newer generations of antibiotics adequate MIC levels of the antimicrobial drugs in vitreous may be achieved when given parenterally, especially in cases of endophthalmitis due to associated inflammation and resultant breakdown of blood-retinal barrier. Thus parenteral antibiotics may be used, especially in post-intravitreal endophthalmitis which are usually fulminant and aggressive.

- Treatment of post-intravitreal endophthalmitis needs to be tailored depending upon individual cases. The treatment in post-intravitreal endophthalmitis should be more aggressive as the infection tends to have a worser prognosis. While, intravitreal antibiotics seem to be the most common first treatment in post-cataract surgery endophthalmitis, Early surgical intervention should be preferred in post-intravitreal endophthalmitis. With advancement in surgical techniques and equipments, the aim of surgery is to achieve complete vitrectomy with PVD induction, thereby removing the infectious nidus and substantially decreasing toxic and inflammatory load. Undiluted specimen should be sent for culture studies and antibiotics should be instilled in the vitreous cavity at the end of the surgery thereby achieving increased intraocular antibiotic concentration. A prospective randomized controlled trial at our centre for post-traumatic endophthalmitis compared outcomes in patients that underwent core vitrectomy alone, to patients that underwent complete vitrectomy with silicon oil endotamponade. The study showed that complete vitrectomy with primary silicone oil endotamponade improved anatomical and functional results in post-traumatic endophthalmitis. Apart from being used as an internal tamponade after vitrectomy, silicon oil has been suggested to possess antimicrobial activity in post-intravitreal injection endophthalmitis.

REFERENCES

“Accuracy is essential to beauty.” – Ralph Waldo Emerson

Cataract surgery offers an opportunity to not only correct an underlying pathology, but also to improve on the refractive situation that existed prior to the surgery. Towards this end, the art and science of IOL power calculation needs to be mastered by all cataract surgeons. This is the first of a three-part series in which we will examine the practical aspects of determination of IOL power.

Biometry denotes the physical measurement of ocular dimensions that are used as input variables for the various formulae later. The two most important parameters that need to be measured are the axial length and the corneal power.

**TIMING**

It is vital to perform biometry well before the surgery is performed. This gives the surgeon adequate time to counsel the patient and to factor in his or her special needs. It also allows time to calculate the IOL power, and to arrange for unusual powers or special IOLs well in time.

**BIOMETRIST**

Biometry is a matter of great responsibility and should only be performed by the surgeon, or a well-trained assistant. A few minutes invested in biometry can save the patient from a lifetime of distress.

**KERATOMETRY**

Various devices can be used to measure the corneal power. In reality, all devices measure anterior corneal curvature, rather than power. The corneal power, or its capacity to bend light, is then determined by applying the refractive index of the cornea.

A good keratometry is essential to the process of IOL power calculation. This value is directly used for the vergence equation by all modern theoretical formulae. It is also used to estimate the height of the corneal vault and thereby to indicate the final position of the IOL within the eye, the so-called Effective Lens Position (ELP). A difference in the keratometric values along different axes forms the basis for estimating and evaluating corneal astigmatism. This component is needed for the planning of premium IOLs such as toric and multifocal lenses.

There are several things to be borne in mind to obtain the perfect keratometry values. Some of these are general guidelines that hold true irrespective of the instrument in use.

**GENERAL GUIDELINES**

1. **Calibration:** The instrument must be calibrated periodically. There are two ways of doing this. One way is to use the calibration sphere or the test eye, which the manufacturer has supplied. The second method is to appoint a designated person like a permanent staff member or the surgeon, whose keratometry values have been recorded and confirmed several times. Periodic re-testing of this person’s keratometry readings should be sufficient to detect calibration errors in the normal course.

2. **Dark room:** Since keratometry relies on analysing reflected images, a dark room helps by eliminating extra light.

3. **Untouched cornea:** Any contact procedures such as tonometry or A-scan should be performed after the keratometry.

4. **Tear Film:** The corneal reflections are actually coming off the tear film. A poor tear film can cause scatter of the reflected light, producing wavy, crenated images that reduce accuracy. Even in eyes with normal tear films, the use of eye drops just prior to keratometry can produce this effect. For this reason, it is recommended not to use any eye drops till after the keratometry has been recorded. The only exception is the use of preservative-free lubricant eye drops, which actually help by forming a smooth layer, especially in patients who have an element of dry eye.

5. **Contact Lenses:** Patients who have been using contact lenses have physically altered corneas. Though there is some debate about how much time must pass after removing contacts, a minimum of three days is recommended.

**MANUAL KERATOMETRY – THE BAUSCH AND LOMB MODEL**

This device (Figure 1) is a very popular instrument till date. Following a set protocol when using it can help obtain very accurate readings.

Before recording, make sure that your own refractive error is adjusted on the eyepiece.

The patient should be instructed regarding the procedure. After stabilizing the head ask the patient to look straight ahead, and position the occluder in front of the other eye. In this position, the vertical centre of the patient’s eye should be at the same level as the vertical centre of the keratometer drum-face. If this is not the case, align it properly by changing either the chin-rest position, or the height of the drum.

Look through the eyepiece and visualize the mires. The unfocussed mires will appear as shown in (Figure 2). Adjust the focus knob, alignment and elevation to bring the double circle into a single clear circle, as per (Figure 3). The mires are now focussed but not aligned.
The horizontal reading is obtained by turning the horizontal measurement drum, which is to the left of the instrument and marked ‘HORIZONTAL’. Turning this drum will move the horizontal circle. Adjust this till the ‘plus’ signs lying between the two bottom circles are aligned. Similarly, adjusting the ‘VERTICAL’ measurement drum on the right side will move the two circles placed one above the other. Keep adjusting this till the ‘minus’ signs overlap. At this point, the plus signs may be a little above one another, as in (Figure 4). This happens when there is corneal astigmatism and the instrument is not properly aligned to the steep and flat meridians. To correct this, rotate the instrument tube on its long axis, while observing through the eyepiece, till the overlap is perfect, as in (Figure 5). While doing this, you may need to fiddle with the horizontal and vertical measurement drums. Once the end-result is obtained as in the patient can be asked to move back. Note the readings off the measurement drums.

Record the values as Dioptres @ axis for each meridian (Figure 6). This format is termed as the power notation, and it helps to distinguish the values from refractive data, especially when describing astigmatic values. Record values for both eyes, and take an average of at least three readings to be sure. Since these values are vector values having both a direction and a magnitude, it is advised to use vector techniques to obtain average values. One way of doing this is to use the Average Keratometry Calculator, a free MS Excel worksheet available on the web (Figure 7).

**AUTOMATED KERATOMETRY**

There are many devices that perform automated keratometry:

1. Standalone Autokeratometers
2. Autorefractokeratometers
3. Keratometers integrated with optical biometry systems

All these devices follow the same general principle, that is, measurement of reflected images to determine the corneal curvature. The differences lie in the size of the corneal cap that is measured, and the refractive index used to convert the radius into dioptres (Figure 8). These may appear to be minor variations, but can translate into significant changes in the final IOL power calculation. For this reason, it is important to optimize the lens constants according to data obtained from one’s own practice. The process of optimization takes care of all such systematic errors, and will be discussed in detail in part two of this series.

Automated keratometers differ from manual ones in several ways.

1. There is no observer eyepiece, so the values recorded are independent of the observer’s own refractive error. This improves the consistency of results.
2. The observer can see the image of the cornea and the position of the mires on the display unit. This allows much better centration of the mires.
3. Multiple readings are taken and averaged by the machine, and a printout is available. This reduces the chances of error due to mis-reading of the data.
4. Readings are available in small increments, depending upon the device specifications. This improves the overall accuracy. If your device gives you the option of recording keratometry values in say, 0.25D or 0.12D steps, make sure to select the 0.12D step.
5. No special measures are needed to record the axis of astigmatism.
6. Automated systems record more...
readings, and are much faster than manual units. This speed is helpful not only to improve the surgeon’s workflow, but also in the evaluation of patients who cannot sit still for long, such as children.

There is only one real limitation of automated systems. If the cornea is uneven or the mires are distorted, the algorithms, at present, are insufficient to cope with the situation. Fortunately, it is easy to spot these errors. The trained observer can just look at the mires and know that the reading is going to be inaccurate (Figure 9).

In such situations, manual keratometry can help. Human observers are able to get an approximate best-fit overlap of the mires even in rather extreme conditions. These approximate values are likely to be closer to the actual keratometry than an erroneous automated keratometry reading.

TOPOGRAPHY AND SCHEIMPFLUG IMAGING

Corneal topography is mapping of the contours of the anterior cornea. It gives information about the curvature of the cornea at multiple points. The area measured is much larger than what conventional keratometers measure (Figure 10).

Topography is particularly advantageous in two situations.
1. It can give a better overall sense of the direction of astigmatism, and whether it is a regular or irregular astigmatism.
2. It can help ascertain the asphericity of the cornea. This information is useful when implanting aspheric IOLs.

Scheimpflug imaging is a special technique used in devices such as the Pentacam or the Galilei. It enables true evaluation of the posterior corneal surface in addition to the anterior cornea. This allows a more accurate determination of corneal power. A second advantage is the assessment of posterior corneal astigmatism, which can play a crucial role in deciding the outcomes of toric lens implantation.

However, it must be noted that most of the popular formulae were devised with data from conventional keratometric readings. The inner workings of these formulae take into account many of the errors that arise from the assumptions made when recording keratometry. For this reason, simply recording a perfect corneal power will not translate into better IOL power predictions. In fact, by over-riding the compensations inherent in the formulae, such a perfect reading for the corneal power will actually decrease the accuracy of the prediction per se. This is not to say that one must not strive for perfection; only that any keratometric technique that is used must be accompanied by optimization of the lens constants to achieve the best results.

A FEW PRACTICAL TIPS

1. Always record the keratometry on two separate occasions, preferably on different machines by different observers. One of these machines should be well tested and known to be accurate. This is the designated device for acquiring data, while the other can be used to cross-check for gross errors.
2. Always record keratometry for both eyes, even if one eye has already been operated upon.
3. In the presence of a mature cataract, the patient is unable to fixate properly. It helps to close the other eye and ask the patient to look straight ahead.
4. If the upper lid is coming in the way, gently lift it till the mires become visible. Be sure not to press the eyeball in any way when doing this.

WARNING SIGNS

Despite our best efforts, errors creep in. To minimize these errors, a set of suggestions has been formulated. This is a checklist to indicate that something is amiss, and it warrants a repeat measurement (Figure 11).

AXIAL LENGTH

The axial length of the eye is defined...
as the distance that light travels before it encounters the photoreceptors at the fovea. It is the optical path length within the eye. Therefore, any device measuring the axial length should measure the distance between the anterior surface of the cornea at its apex and the fovea.

However, just as keratometry does not actually measure corneal power, axial length measurement devices do not measure distances. Ultrasonic devices measure time taken by a wave to travel the length of the eye and come back to the origin. Once the time taken for the journey is known, the distance traversed can be calculated quite easily using the formula:

\[
\text{Distance} = \text{speed} \times \text{time}
\]

In the case of ultrasonic devices, the wave in question is a high-frequency sound wave, usually in the range of 10 mHz. In case of optical devices, laser light beams are used.

**CONTACT ULTRASOUND**

"The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself. Therefore, all progress depends on the unreasonable man." - George Bernard Shaw.

For nearly two decades after Ridley’s landmark first IOL in November 1949, the choice of implant power remained a non-issue. Early adjustments quickly removed the large errors encountered initially, and a strategy known as the universal IOL power was followed. This essentially meant that a standard +18.0 D Binkhorst pre-pupillary lens was used for all patients, leaving the patient with approximately the same refractive error as he or she had before the cataract developed. This was considered a reasonable thing to do, and quite satisfactory by most. A few surgeons decided to improve things, adjusting the power to account for preoperative myopia or hyperopia, and soon there were nomograms available for these adjustments, but there was no formula.

The very first IOL power calculation formula was published by Fyodorov et al in 1967. This was a theoretical formula that needed the axial length and keratometry as the input variables. The publication of this formula pushed the exploration of ultrasound as a modality to measure the axial length.

In the early 1970s, Russian and Dutch researchers began using ultrasound, and Kenneth Hoffer brought the technology to the USA. About this time, Ossoinig of Austria had already developed a special immersion cup that improved the accuracy of the process.

By today’s standards, A-scan ultrasound then was an amazingly complex process. The operator had to photograph the spikes on the screen using a Polaroid camera, and then make physical measurements on the photograph, using callipers. Hoffer set about advancing the technology further, and in collaboration with Sonometrics Inc of Boston, a machine was developed. This was specifically built for IOL power calculation, it had an applanation cone that could be applied directly to the cornea, and it featured a fixation light.
Most importantly, it was equipped to digitally read the axial length, without the need for photography and measurement, and this simplified the technique greatly. Very soon, this piece of equipment gathered much favour throughout the world.

The establishment of ultrasound axial length measurement as a gold standard and its worldwide penetration led to a flurry of IOL power formulas being developed. The ophthalmic world began to seriously consider the possibility of achieving postoperative emmetropia by design rather than by accident. It was these advances, combined with the evolution of lens design and surgical technique, which finally led the FDA to give approval to intraocular implants in 1981, more than thirty years after Ridley’s pioneering work.

MODERN CONTACT ULTRASOUND BIOMETRY

Despite the better accuracy of immersion and optical methods, contact biometry remains a much valued technique. The reasons are not far to seek:
1. It is easy to learn.
2. It is fast to perform.
3. It is comparatively inexpensive.
4. It can be done in the presence of any grade of cataract or axial opacity.
5. It is fairly accurate.

THE TECHNIQUE

The procedure is explained to the patient, and the eye is anaesthetized. The patient sits upright, facing forwards. The tip of the probe is brought in touch with the apex of the cornea, while the patient is asked to look at the fixation light. There should be no sideways movement of the probe, and the touch needs to be light, so that the corneal compression is minimized.

Take care that the cornea is indeed being touched. It is possible to obtain a reading through the small fluid bridge even if the probe is a little away (Figure 12). This will produce an error of measurement. This error is more likely to happen if the conjunctival space is full of lubricating fluid, viscous gel or ointment. On the other hand, if the eye is too dry, the fluid bridge will be insufficient for proper coupling between the probe and the cornea. It will be difficult to get a reading in such a situation. This can be remedied by asking the patient to blink rapidly a few times. Alternatively, one may instil a lubricant eye drop, making sure that any excess is removed.

Most modern instruments will automatically freeze the scan when good echoes are obtained. As a rule, modern instruments record and display multiple readings within a few seconds. The data can be read off the screen, printed out, or used directly to calculate IOL power on the A-scan device itself. Many machines offer multiple formulae as well as a database component that helps with optimization.

The measurement of axial length has been the biggest source of error in the estimation of IOL power in the past, so it is worthwhile to learn how to minimize the measurement error here.

TIPS FOR ACCURATE AXIAL LENGTH MEASUREMENT

1. Ensure periodic calibration of the device. A test eye is provided by the manufacturer.
2. Ensure correct velocity settings. Since the A-scan measures time and converts it into distance using velocity, any error in the velocity setting will affect the output. For example, using aphakic settings for an eye with cataract will significantly change the final reading.
3. Ensure that the correct mode is set; contact or immersion.
4. Use appropriate gain setting. Too low a setting will make it difficult to acquire the readings, while too high a setting will truncate the tops of the spikes and produce artefacts.
5. Minimize corneal compression by practising a gentle touch and using the patient’s facial prominences as support.
6. Get the correct alignment. This can be done by asking the patient to fixate on the fixation light, and verified later by assessing the structure of the spikes.
7. Ensure good spikes (Figure 13). a. The retinal echo should rise as high as the corneal echo.
b. All spikes should rise steeply.
c. The tops of the spikes should be pointy rather than flattened; the latter indicates that the gain setting is too high.
d. A series of spikes of decreasing height after the scleral spike are a necessity. These come from the orbital fat. Lack of these echoes indicates that the probe is misaligned along the optic nerve.
8. Measure both eyes, even if one eye has already been operated upon.
9. Average multiple readings and ensure low standard deviation.
10. Assess tear film adequacy.
11. Record on two separate occasions.
12. Be extra careful with very short or very long eyes.
13. Repeat measurement if you come across warning signs (Figure 14).

IMMERSION BIOMETRY

The immersion technique involves creating a fluid bath in which the ultrasound probe is immersed. This can be done using a variety of special shells, of which the Prager shell (Figure 15) is the most popular. The advantage of using this fluid bath is that there is no direct physical contact between the probe and the cornea. This eliminates the effect of compression, one of the most common sources of error in axial length measurement. Consequently, use of the immersion technique greatly increases the accuracy of the measurement.

The procedure is usually done with the patient in the supine position. A towel around the shoulders is a good idea. A Prager shell is then applied by gently prising open the lids and placing the base of the shell so that it gently but firmly touches the limbus all around.

Fluid is injected through the small tube at the side, till the tip of
the probe is well submerged. Care is taken to avoid bubbles as the fluid is introduced. Presence of bubbles along the measurement path will lead to erroneous results.

The patient is asked to look at the fixation light and the probe is activated. Most devices quickly record a series of measurements. If the standard deviation of these readings is less than 0.06 mm, remove the shell and evaluate the graph. If the standard deviation is higher, it is possible to reset the machine and record another set using the same fluid bath. This saves the patient, and the biometrist, the trouble of re-applying the Prager shell.

The procedure is a little more complex than recording applanation readings, but the effort is well worth it. It takes only a few recordings to get used to it. With practice, it is quite easy to do this procedure even with the patient sitting upright, with a little backwards tilt of the head.

TIPS FOR IMMERSION A-SCAN

1. There is a mark on the immersion shell. Make sure that the tip of the probe is placed such that it is at the level of this mark. In the original Prager shell, an auto-stop ensures accurate placement.
2. The probe tip should be totally submerged in the water bath.
3. There should be no air bubbles in the water bath. Look carefully, as sometimes tiny bubbles stick to the probe tip. These may not be immediately apparent.
4. Make sure that the machine is set to immersion mode, and the correct velocity settings have been chosen.

THE CALF METHOD

One of the sources of error when performing ultrasound measurements is the issue of velocity of sound. Since the device only measures time taken for the ultrasound to return to the probe, the calculation of axial length is a function of sound velocity. Some devices use different velocities for different components of the eye, while others use an average velocity for the whole eye.

This can be an issue because the velocity through the cornea and the lens is significantly different from the velocity through the aqueous and vitreous. The average velocity is determined using data from an average eye. However, for longer and shorter eyes, the actual average velocity can be quite different. This is so because the crystalline lens thickness is not a function of axial length. In shorter eyes, it occupies a greater proportion of the axial length than usual. In longer eyes, the relative space occupied by the lens is lesser.

Holladay has suggested the CALF method to minimize the error. CALF stands for corrected axial length factor.

The technique involves making the immersion axial length measurement at a velocity of 1532 m/s, which can be done by setting the machine to the aphakic mode. Holladay, Hoffer, Hill and others have recommended doing this as a routine for all cases. The measured axial length is then converted to phakic axial length by adding 0.32 mm, the CALF.

This addition takes into account a standard lens thickness and corneal thickness for a seventy year old person. While these values are not exact, they help by confining the error to the difference between the actual and the standard lens thickness, which is usually quite small.

OPTICAL BIOMETRY

In 1986, A.F. Fencer performed the first in vivo axial length measurement using light. This was then developed further by Prof Haigis and Zeiss, leading to the release of the IOL Master by Carl Zeiss Meditec in 1999. Now, several manufacturers have released their own versions of optical biometry.

These devices also measure the corneal power, as well as several other parameters. This makes them a convenient single instrument that obtains all the necessary inputs for IOL power calculation. However, the real triumph is in the measurement of the axial length.

The IOL Master measures axial length using dual-beam partial coherence interferometry. What this means is that instead of sending out ultrasound, light from a 780 nm near-infrared laser is used to measure the optical path, from the anterior corneal vertex to the retinal pigment epithelium (RPE) located at the fovea centralis.

Several readings are recorded, and current algorithms are capable of processing the data to extract the best possible results.

Optical biometry is considered the gold standard measure of axial length when it can be obtained. There are several reasons for this.

1. The entire process is largely independent of the observer, and offers superlative reproducibility of results. For the various parameters measured, the intra-observer variability is in the range of 10–40 μm. This translates to a virtually zero learning curve.
2. It is a non-touch technique, which eliminates the problems of corneal compression, the risk of infection, and the difficulties of making the measurement in an uncooperative patient. It is safe and practical to perform the biometry even on the day of the surgery.
3. The patient looks at the light source, which ensures that the measuring beam is on the visual axis. This is especially relevant in the presence of a posterior staphyloma.
4. The optical beam is much narrower than the ultrasonic waveform.
5. The resolution of any device depends upon the wavelength of the beam that it uses. The shorter the wavelength, the better the resolution. For a 10 mHz sound beam, this wavelength is 0.16 mm. For the infra-red laser, the wavelength is 0.0008 mm.
6. Optical biometry measures the entire optical path, right up to the RPE, and includes the retinal thickness. Ultrasound beams are reflected off the internal limiting membrane. The retinal thickness has to be inferred, introducing a source of error. Interestingly, many of the presently popular theoretical IOL power calculation formulae were developed using ultrasonic data. These incorporated best-fit solutions to estimate the retinal thickness from the measured data. With the availability of true axial length, one can expect to improve formula performance by removing the retinal thickness factors, but this has not yet been done.
7. In several special situations such as the presence of an intraocular lens or a silicone oil filled eye, the ease and accuracy of optical biometry is far better than that of the ultrasonic techniques.

The only real problem posed by optical biometry is the inability to function in the presence of significant media opacity. Quite simply, if light cannot get through, the optical path length can’t be measured. At times, even minor but axial opacities such as posterior subcapsular cataracts can play spoilsport.

These limitations underscore the value of understanding and implementing
both optical and ultrasonic biometry in one’s practice.

THE LAST WORD

Accurate IOL power calculations depend upon accurate input values. The surgeon must always ensure that biometric measurements are of the highest standard possible. The key elements are ensuring well-maintained equipment that is periodically calibrated, having a set protocol, making multiple measurements, and understanding the processes at work behind these measurements.

The second part of this series will discuss how these measured values are used to generate the IOL power, and the strategies available for minimizing errors.

REFERENCES

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Financial Interest: The authors do not have any financial interest in any procedure/product mentioned in this manuscript.
Our optimal objective for presbyopia and cataract patients is to provide a full range of focus with the least possible compromise in quality of vision. Customized IOL selection and use a mix-and-match approach to achieve this goal of functional spectacle independence while minimizing compromises in quality of vision.

The process of learning which IOLs work for which patients takes time, and this is especially true for new IOL technologies for which there are not yet extensive clinical data. The Tecnis Symfony Extended Range of Vision IOL (Abbott Medical Optics; Figure 1) bilateral implantation in refractive lens exchange and cataract surgery patients because the lens’ optics create fewer tradeoffs to the quality of vision than multifocal IOLs.

**HISTORY**

Presenting a 28 year old young male, sales manager by profession, with complaints of decreased vision in both eyes right more than left eye. Preoperative using spectacles were -3.0/-2.25 x 90 for the right eye and -1.0/-0.75 x 180 for the left eye since early childhood for the last 16 years. His ocular and systemic histories were unremarkable. The patient does not have a keen interest in highway driving though within city driving is around 5 to 10 kms per day. After reviewing the patient education materials we provided to him, he expressed interest in a presbyopia-correcting IOL.

**EVALUATION**

On examination, the best-corrected visual acuity (BCVA) with glass was 20/20 in right eye (RE) and 20/20 in left eye (LE). Refractive error was -3.50/-2.50 x 90° (RE) and -1.00/-1.00 x 100° (LE). Autokeratometry value of corneal curvature was 45.98D/5@95/43.72D@5 (vertical/horizontal) in the RE. Axial length of the eye was determined by Optical Biometry and the values were 24.65 mm (RE), and 22.84 mm (LE). Systemic evaluation did not detect any abnormality. Slit lamp examination revealed bilateral presenile cataract in both eyes (RE>LE). Indirect ophthalmoscopic examination of the posterior segment was unremarkable with the cup-disc ratio being within normal limits in both eyes. Emmetropic intraocular lens (IOL) power calculation using SRK-II formula using IOL Master was +16.00 in the RE and +18.50 in the LE (A-constant 119.3). The patient was planned for toric multifocal IOL in the right eye with the following preoperative planning. Using Ray tracing technology (HOYA) for toric planning for the right eye, Verion guided customization (Figure 2) and AMO online toric calculator images (Figure 3) are given below.

**SELECTING CUSTOMIZED IOL FOR PRESBYOPIC & CATARACT PATIENTS**

Sonu Goel, Sonai Mukherjee

**Figure 1:** An echelette design introduces a novel pattern of light diffraction that elongates the focus of the eye, resulting in an extended range of vision.

**Figure 2:** Vision funded customization.
TREATMENT

Preoperative marking (Figure 4) with the toric bubble reference corneal market at the 3, 6, and 9 o’clock positions with patient sitting upright.

Phacoemulsification by a 2.2 mm temporal clear corneal incision (Figure 5): was done.

Technis Toric Symfony was implanted in the right eye for the patient (IOL model ZXT375) AMO Technologies. Postoperatively the patient UCVA was 20/20. Ray Tracing evaluation of Modulation Transfer Function (MTF) & Contrast sensitivity images are given below (Figure 6 & 7).

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Images & Spatial Frequencies

The MTF represents the manner in which the optical system under consideration attenuates the contrast of the image that it forms with regard to the observed object. This indicator may be calculated on the basis of the study of the aberrations deforming the wavefront. Retinal Spot Diagram (RSD) Concept.

Obtaining Point Spread Function (PSF) and MTF

When a set of points is sequentially projected in the entrance pupil a retinal spot diagram (RSD) is created. The RSD contains all the information related to the patient’s refraction, aberrations, and point spread function (PSF). Analysing the RDS’s morphology, we get an idea of the degree of the wavefront’s qualitative aberration. The smaller the RSD the higher the concentration of photons that reaches any point of the retina. From the RSD we obtain the PSF. PSF shows the image obtained in the retina when the patient sees the source of a point of light. The smaller and the sharper the better. The MTF describes how the optical system reproduces detail from the object to the image produced by the lens; therefore, both the MTF and PSF help to describe the optical system’s ability.

DISCUSSION

Perhaps the most important factor in determining if a patient is a good candidate for Multifocal IOLs is the patient’s willingness to accept some compromise in the clarity of your distance vision for the convenience of being less dependent on computer glasses and/or reading glasses after cataract surgery.

If the patient is not willing to accept this type of compromise, or occupation requires best possible distance vision at all times or excellent night vision—for example, as in a pilot or someone who spends a lot of time driving in unfamiliar areas at night—then such patients are not a good candidate for multifocal IOLs. These patients may be better served with standard monofocal IOLs for optimal distance vision—even though this means that they will need bifocals, progressive lenses or reading glasses to see clearly up close.

Also, if in the presence of a pre-existing visual condition other than cataracts that affects vision in one or both eyes (macular degeneration, for example), standard monofocal IOLs rather than multifocal IOLs, (which require good visual capability in both eyes for best results) would be the optimal.

FINANCIAL DISCLOSURES: No author has any financial interest in any of the products/procedure mentioned in the manuscript.

FELICITATION

Prof. Atul Kumar, MD, FAMS, Chief of Dr Rajendra Prasad Centre for Ophthalmic Sciences, AIIMS, New Delhi has been conferred the prestigious “B.C. ROY NATIONAL AWARD” by the President of India at Durbar Hall, Rashtrapati Bhawan, New Delhi on 1st July 2016.
Dry eye disease (DED) is one of the common disorders of the eye with an estimated prevalence of 5.5% – 33.7% worldwide. Due to its high prevalence it is a public health concern with a significant economic burden. The hallmarks of DED include discomfort, visual disturbance and tear film instability with potential damage to the ocular surface. It is accompanied by increased tear film osmolarity and inflammation of the ocular surface. Though, there has been widespread interest in understanding the disease and developing new treatment modalities for combating the ocular morbidity caused by it, a complete understanding of its symptomatology still eludes us at the moment. Though tear film analysis give a fair understanding of symptoms, it is unable to explain symptoms in all those suffering from Dry eye disease (DED). Predicting this population also poses a major challenge in the management of DED. It is therefore imperative to identify diagnostic modalities that can accurately predict patients whose symptoms may not resolve with conventional therapy or may require additional dietary or environmental interventions along with topical therapy to ensure a favourable prognosis.

This article highlights the role of In vivo confocal microscopy (IVCM) in imaging corneal nerves and the changes in nerve morphology seen in DED as well as the role of Vitamin deficiencies and inflammation in etiopathogenesis of DED.

### QUANTITATIVE ANALYSIS

Quantitative analysis of nerve fibers has recently been introduced and is performed using Automatic CCMetrics software, Ver. 1.0 (University of Manchester, UK). The parameters quantified as shown in (Figure 1) include corneal nerve fibre density (CNFD), the total number of major nerves per square millimeter; nerve fibre length (CNFL), the total length of all nerve fibers and branches (millimeters per square millimeter); nerve branch density (CNBD), number of branches emanating from major nerve trunks per square millimeter; total branch density (CTBD) the total number of branch points per square millimeter; the nerve fibre area (CNFA) and the total nerve fibre area per square millimeter and the nerve fibre width (CNFW) the average nerve fibre width per square millimeter. Dendritic cells (cells/mm2) have been quantified using Cell Count software by identifying bright individual dendritiform structures with cell bodies in each image at the level of basal epithelium or at sub-basal nerve plexus. Bright cell bodies with and without dendritic processes or extensions have also been identified.

### DISTINCTIVE FEATURES OF DRY EYE

**Epithelial changes**

Significantly decreased cell densities in the superficial, intermediate, and basal epithelial layers, presumably due to increased desquamation of the superficial cell layer and activation of corneal keratocytes in the stroma has been seen in patients with dry eye.

**Dendritic cells**

Increased corneal dendritic cell density has been demonstrated in patients with DED. A significant increase in corneal dendritic cells has been found to have positive association with higher OSDI scores. This is a possible explanation for ocular discomfort that is out of proportion to signs in a group of patients suffering from EDE. An increase in the number of dendritic cells in close proximity to the sub-basal nerves has been shown in patients with severe symptoms (Figure 2 & 3). Dynamic in vivo assessment of the central corneal inflammatory cell density may serve as an indicator of DE severity and provide new insight for DE treatment.

**Sub-basal nerve plexus changes**

Various publications...
have reported different findings in the sub-basal nerve plexus in EDE. Nerve fibre density has been found to decrease with increasing severity of dry eye whereas branch density and width show an increasing trend with increasing inflammation. Nerve fibre area has been found to increase initially but decrease in the later stages of EDE. Nerve changes may cause neuropathic pain. It has been proposed to be due to peripheral sensitization of neurons or damage to free nerve endings that interdigitate between superficial epithelial cells and are exposed to environmental and/or inflammatory stimuli. The presence of inflammation has also been found to directly and indirectly affect the structure and function of peripheral nerves resulting in altered nociception by secreting neuropeptides which in turn trigger a neurogenic inflammatory response.

The mechanism by which corneal nerves maintain epithelial cell function is not precisely known, but it does involve interplay between epithelial cells and autonomic nerves through various cytokines and nerve growth factors. IVCM has demonstrated increased tortuosity, sprouting and beading of sub-basal nerve plexus along with neuromas due to degeneration and regeneration of nerve fibres (Figure 4). These changes along with reduction in the sub-basal nerves alter the balance thereby affecting basal epithelial cell mitosis and thinning of the epithelium. The basal cells are therefore exposed to noxious stimuli from the ocular surface, which is the seat of inflammation in patients with DED.

IVCM evaluation of conjunctival epithelium in DE demonstrated conjunctival epithelial cyst formation, decreased density of conjunctival epithelial cells, goblet cells and increased inflammatory cell density.

**VITAMIN D**

Vitamin D is a fat-soluble prohormone with the ability to modulate calcium
homeostasis and immune responses. The normal serum level of vitamin D ranges from 30 to 60 ng/ml. There is also growing evidence regarding the potential role for vitamin D deficiency in the pathogenesis of dry eye and chronic ocular pain. It has been shown that patients with vitamin D deficiency have higher OSDI scores and more ocular discomfort.

Theories regarding the role of vitamin D in the etiopathogenesis of ocular pain are listed below.

1) Vitamin D exhibits anti-inflammatory and immunoregulatory properties and its deficiency results in inflammatory or immune mediated dryness of the eyes. Vitamin D also modulates the expression of inflammatory cytokines in various cells, including corneal epithelial cells substantiating the anti-inflammatory/immunomodulatory functions of vitamin D.

2) Vitamin D can influence the severity of symptoms by modulating nociception by regulating nerve homeostasis.

3) Serotonin which can perpetuate a chronic pain response is high in patients with DED and vitamin D is known to affect serotonin synthesis.

4) Vitamin D deficiency results in increased production of nitric oxide, a nociceptive neurotransmitter thereby modulating pain.

5) Vitamin D and its agonists have been found to inhibit maturation and induce tolerance in dendritic cells resulting in the arrest of inflammatory processes. Lower vitamin D levels are associated with an increase in DCS with dendritic processes (mature phenotype) which provides supportive evidence for the immunomodulatory role of vitamin D on DCS.

6) Low vitamin D level can result in severe symptoms by directly influencing nociception on nerve fibers and/or indirectly by lack of negative regulation on DCS activation/migration and inflammatory responses.

Role of inflammation in ocular symptomatology in dry eye

Inflammation has been found to play a central role in the pathogenesis of dry eye. Both local and systemic factors that regulate inflammation may have played a role in causing ocular discomfort in our patient. In dry eye, inflammation leads to increased epithelial permeability and rarefaction of basal epithelial cells. Changes in the subbasal nerves...
coupled with epithelial changes lead to microscopic breaks in the Bowman layer, providing a conduit for inflammatory factors to enter the stroma. Subepithelial inflammation leads to recruitment of dendritic cells along with further irritation of nerves, both of which could be responsible for the pain and discomfort experienced by the patient. Changes in the subbasal nerves may also cause a release of proteolytic enzymes that can lead to further enlargement of the breaks thereby propagating more inflammation. Inflammation may trigger nociceptive endings on the hyperreflective terminal nerve ending (microneuroma) that is exposed through the Bowman break, and this may further contribute to the pain (Figure 5) experienced by the patient.

**Financial Interest:** The authors do not have any financial interest in any procedure/product mentioned in this manuscript.

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**Felicitation**

Congratulations to Dr. Pankaj Varshney for being elected as Hony. Assistant Secretary of Delhi Medical Association for the year 2016-17.
Post LASIK Corneas in Eye Banking - Current Concerns

Archita Singh, M. Vanathi, Radhika Tandon

With the ever changing and advancing ophthalmic techniques and procedures, the modern era has a lot to offer. The present day ophthalmic practice aims not only at 20/20 vision but also ensures to provide for good quality of vision. One such area of ophthalmology is the refractive surgery which over the past few years has evolved and gained popularity. The tremendous improvement in the techniques and the increasing safety profile has further driven the ophthalmologists to freely practice it. Refractive surgeries involve the latest and newest technologies used in the field of ophthalmology with an aim to make it acceptable to the general population. The present era of Femtosecond assisted - LASIK and SMILE offer a bladeless pain-free experience for the patients thus increasing its demand. Refractive surgeries form a significant component of an everyday ophthalmic practice which can be attributed to the ever increasing demand of the population desiring to have a spectacle free life.

But as we boast of the advances in the ophthalmic procedures there are certain questions which remain unanswered. What are the long term results? Though we have succeeded in offering good quality vision to the patients with post-refractive surgery cataracts and we have prevented as well as managed post refractive surgery ectasias and other complications. The question that remains unanswered is “What happens when these post LASIK eyes are donated for a noble cause”.

Another area of key interest and advancements in ophthalmology is corneal transplantation, whether full-thickness or lamellar. The global burden of corneal blindness has been estimated to be 39 million1. In India, corneal pathology is the third most common cause of blindness. The present estimate shows that 6.8 million people in India are blind due to a corneal pathology and these figures are expected to reach 10.6 million by 20202. As the incidence of corneal blindness increases there is a need to improve the availability of donor corneas. Corneal transplantation is an important part of the national level programs aiming at treatment of corneal blindness.

Our aim here is to understand the future of these post-refractive surgery eyes when they are donated for transplantation. There is a limited literature available which discusses this dilemma of an ophthalmologist.

POST-LASIK CHANGES IN THE EYES

LASIK is one of the most common elective refractive surgical procedures performed world-wide3. It is known that post LASIK a number of changes are noted in the cornea, particularly the corneal biomechanical changes. In eyes that have undergone a refractive procedure, the induced changes in corneal thickness, curvature and shape may reduce their suitability for transplant procedures. Few of the changes noted are as mentioned below.

Post refractive surgery there may be flattening or steepening of the central cornea, corneal thinning, interface haze, induced aberrations which decrease quality of vision. Laser in situ keratomileusis which involves stromal ablation alters the refractive index constant and changes in keratometry reading. These changes in the cornea increase the risk of unpredictable visual outcomes following keratoplasty. Also in the present scenario of lamellar keratoplasty and use of ultra-thin lenticules, unpredictable and inadequate tissue cuts maybe another concern. Thus it is important to recognise these donor tissues.

SCREENING POTENTIAL DONOR TISSUES

A good history taking at the level of the eye bank staff and on-duty medical officer carrying out the retrieval procedure is the basic need particularly the details about any previous refractive procedure. But often the history is missed or unknown by the family of the deceased. The routine screening protocol for donor corneo-scleral tissues using a slit lamp biomicroscopy may fail to identify these donor tissues. Though studies show that slit lamp screening method has the potential to recognise around fifty percent of eyes with LASIK flap4 in the hands of experienced eyebank staff.
Use of certain specialised videokeratographs or anterior segment optical coherence tomography on potential cadaveric eyes can help identify these corneas and help determine suitability.

Videokeratographs (VKG) based on the placido disc principle can be used in identifying post-LASIK eyes. Limitation of this technique includes a good quality and regularity of the corneal epithelium and the need to raise the intra-ocular pressure, thus this can be done in cases where full globes has been retrieved and not just the in-situ excision of corneoscleral rim. Adequate moistening and lubrication of the overlying epithelium can help improve the curvatural measurements.

Role of Orbscan which utilizes both placido-disc and slit-scanning technology has been evaluated for recognition of these corneas. Studies showed that orbscan topography and thickness maps together can help detect up to 63% cases of post-LASIK eyes. The disadvantage of the topography based methods is the inability to maintain sterile condition in view of the need to take out the retrieved globes from the storage media. Thus the use of these procedures on a routine basis raises the concerns about risks of infections in keratoplasty. These techniques can also be used for on site evaluation of donor cornea tissues before in-situ excision.

To overcome this issue of sterility, Anterior Segment OCT can be a useful modality in terms of a non-contact method which can evaluate the tissue while in the preservation media. Thus Anterior segment OCT can be a useful modality for screening purpose. High reflectivity may be noted at the LASIK flap level as compared to the posterior stroma, but this fades with time as the duration of eye retrieval from the time of refractive surgery increases. Also the reflectivity of the LASIK flap is less in donated corneoscleral rims in comparison to in vivo eyes. This can be attributed to increased stromal hydration in view of declining endothelial function in the storage media and decreased tension of the retrieved tissue as compared to an intact globe.

The corneal parameters which can be assessed to differentiate LASIK treated corneas from un-operated corneas include anterior curvature measurements. Anterior corneal curvature was found to be less in LASIK operated eyes as compared to the other.

It was also seen that the corneal curvature is more in retrieved corneoscleral rims as compared to in vivo intact eyes. Following retrieval stromal hydration and presence of descemet’s folds affect the posterior corneal curvature more and the effect on anterior corneal curvature is minimal.

The difference between central and peripheral corneal curvature is another useful parameter. The difference if more than two standard deviations for the mean for normal unoperated corneas is considered significant and is suggestive of a corneal refractive procedure.

The other significant parameter is to assess the variation in pachymetry maps and comparison of central and peripheral corneas.

INTRAOPERATIVE COMPLICATIONS

Intraoperatively surgeons may encounter problems such as difficulty in handing of the tissue, difficulty in lamellar dissection, loss of suction while trephination, difficulty while suturing and rarely splitting of corneal lamellae. Laser assisted in situ keratomileusis is not known to affect the specular count. But excessive manipulation intra-op further increases chances of endothelial cell loss.

POSTOPERATIVE COMPLICATIONS AND OUTCOMES

The postoperative outcomes are unpredictable in terms of the keratometry and the residual refractive error. The post LASIK corneas may be flatter or steeper and the treated optical zone may not coincide with the pupil of the recipient eye thus increasing the aberrations and hampering the visual outcomes due to ametropia and irregular astigmatism. Use of such corneas in lamellar keratoplasties (anterior) may have a double interface postoperatively.

The wound healing may be impaired with increased chances of epithelial ingrowths. Persistent epithelial defects as post-refractive surgery eyes have higher chances of dry eye syndromes. The risk of blunt trauma induced damage is higher in post-LASIK corneas.

As these donor tissues are often unidentified, even after an uneven keratoplasty with the best of the techniques the refractive outcomes are incalculable.

IN CASE OF ACCIDENTAL TRANSPLANTS

As there are no specific guidelines, the risk of accidental transplants remain high, therefore certain points should be kept in mind while assessing tissue suitability for transplantation. It is important to inform the recipient who received the transplant as well as the eye bank concerned so that the fellow eye may not be used for transplant. A graft exchange maybe planned in case of poor postoperative vision and poor clinical condition of the graft. The status and condition of the graft may be observed without any further intervention if the visual acuity is good; graft is clear and patient consents and is willing for long term close follow-ups.

There have been a few case reports where though patient received cornea which had undergone LASIK, the graft was not exchanged in view of acceptable visual and anatomical outcomes.

POST LASIK CORNEAS IN ENDOTHelial KERATOPLASTY

The Anterior Stromal Flawed (ASF) corneas which may not be suitable for full thickness keratoplasty may be used for Posterior deep lamellar keratoplasty. It is important in such cases the surgeon should determine the corneal thickness appropriately to
prevent perforation and also ensure that there are no imperfections in the donor lenticule. Retrospective studies show that endothelial keratoplasty using ASF tissues does not seem to affect the postoperative refractive and topographic outcome. Also there was no increase in the risk of donor lenticule dislocation. In 2005 EBAA revised standards to use corneas with good endothelial densities but an unfit anterior stroma for posterior lamellar endothelial keratoplasty. Currently EBAA allows the tissues with anterior pathologies which fail to affect the posterior stroma and endothelium to be used for DSAEK. But this does not rule out the need for appropriate screening of donated tissues as better knowledge about the level and orientation of LASIK flaps improves results which are comparable with untreated donor tissues.

CONCLUSION

With the ever increasing demand of donor corneas in our country it remains important to identify post refractive surgery donor eyes. The Eye Bank association of America contraindicates the use of post-refractive surgery corneas for the purpose of transplant especially full thickness. Thus the increasing trend of elective refractive surgeries increases the challenges of the eye banking with need of advanced technology to identify post-refractive surgery corneas. At present there are no current guidelines which quote the protocol for screening these eyes and the inclusion-exclusion criteria. These corneas may be used successfully in cases of endothelial keratoplasty with caution.

But the dilemma continues, as on one hand transplant of these eyes are associated with unpredictable postoperative outcomes on the other hand the donor pool will be compromised with increase in the number of excluded donor tissues in view of refractive procedures. The need of the hour is to develop technology and techniques to identify the potential donor corneas and to enhance the modern technology for predictable refractive outcomes post corneal transplants and their management. Future studies are required to address the same.

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www. dos-times.org 31
The ReLEx small incision lenticule extraction (SMILE) technique of refractive corneal surgery is a relatively new procedure and there is a lot of excitement with quite a few Ophthalmologists actively adapting this procedure. The introduction of the VisuMax femtosecond laser led to development of the ReLExSMILE technique. In 2006, VisuMax femtosecond laser was used to create the flap as well as a refractive lenticule, for manual removal, all in a single step, popularized as FLEX. Small incision lenticule extraction, a variant of the ReLEx technique, has been proposed as an alternative to the conventional LASIK procedure whereby the femtosecond laser creates a lenticule within the corneal stroma, which can be extracted via a small side-cut incision (2-4mm).

SMILE has been shown to offer several advantages over the current corneal refractive surgeries, including reduced tissue removal, better biomechanical stability, no flap-related complications, and fewer dry eye symptoms. LASIK is a mature technology and gives good results but the refractive market worldwide has stagnated or declined due to some bad press and dissatisfied patients. SMILE offers a new venue for attracting patients and increasing the refractive market.

From the patients perspective SMILE is very attractive as it is a painless, short and minimally invasive procedure. There is almost no special post-operative precautions or care and patients can go back to their normal activities including sports the very next day. Various studies have shown that quality of vision, dry eye status and refractive stability is very good after 3 months. Patients would perceive it as an easier and safer procedure.

Surgeons are looking up to this procedure for the various benefits it offers over LASIK being a flapless procedure. There is less induced spherical aberration than wavefront optimised LASIK as tissue is removed en-block from the periphery without the cosine effect and reduced fluence of excimer lasers. There are fewer variables like environmental factors and energy variation when compared to an excimer laser which may result in more predictable results. There is less long term dry eye with SMILE as compared to LASIK due to better preservation of the sub basal epithelial plexus. The potential benefit of better corneal biomechanics may lead to reduced incidence of corneal ectasia and the ability to treat higher refractive errors safely.

The SMILE procedure is still in its infancy and has to be refined, but many comparative studies with wavefront optimised Femto LASIK show that the refractive results and safety may be comparable or better. There is still a lot of development that has to take place with the lenticule extraction technique. Software for treating hyperopia and mixed astigmatism is being developed and early results from clinical trial sites indicate good success. Centration in the SMILE treatment is dependent on patient fixation and in future hardware for confirming good centration would improve outcomes. Also automatic cyclotorsion compensation for astigmatism has to be introduced. The ability to treat irregular or aberrated corneas with a link to a topographer or aberrometry is still a long way off. The lenticule extraction technique has shown very good stability over time when compare to LASIK or PRK especially for higher refractive errors with very low enhancement rates. Currently the options for enhancement are either LASIK by converting the cap into a flap or surface ablation. There is a possibility of doing re-SMILE for enhancement and I have had some personal experience, and so also a few other surgeons but this is off-label and not promoted by the company.

SMILE is a surgeon based procedure with a learning curve which may be steeper than LASIK or PRK. Optimizing energy levels, learning to dock and centre the eye are important and can be mastered initially by using the VISUMAX laser to create flaps. Identifying the correct tissue planes and easy dissection with minimal tissue distortion improves immediate post-operative recovery. The learning curve with SMILE can be reduced by observation and proper training. There can be complications like suction loss, retained lenticule, lenticule tear which are unique to this procedure and also difficult dissection due to sub-optimal fluence levels which have to be handled properly to ensure smooth outcomes.

We hereby share the outcomes of ReLEx®small incision lenticule extraction (SMILE) for correction of myopia or myopic astigmatism in terms of visual acuity, contrast sensitivity, aberrations, and dry eye in the first 600 eyes treated at our centre with this innovative technology.
This prospective single centre study enrolled 600 eyes from 300 consecutive patients of both gender undergoing bilateral ReLEx SMILE with mean age of 27.4 ±5.6 years.

The eligibility criteria were: myopia between 1 to 10 diopters (D), astigmatism upto 5D, and spherical equivalent upto 10D, age of 21 years or older, a stable refraction for atleast 1 year, the discontinuation of soft contact lenses for a minimum of 1 week and rigid gas permeable contact lens discontinuation for a minimum of 3 weeks, a minimum corneal thickness of 480μm, a residual corneal thickness of atleast 250μm or 50% of original thickness (whichever was higher), the ability to understand and a willingness to sign informed consent, and a willingness to participate in all follow-up visits.

A thorough preoperative examination, including corrected distance visual acuity (CDVA), topography, contrast sensitivity, aberrometry, and dry eye assessment was conducted. VisuMax femtosecond laser system was used to perform SMILE. Patients were followed up on days 1, 15 and at 3 months. Postoperative uncorrected visual acuity (UCVA), CDVA, aberrations, dry eye, and contrast sensitivity during 3 months of follow-up were recorded.

All surgical procedures were performed using the VisuMax® femtosecond laser (Carl Zeiss Meditec, Jena, Germany) by an experienced refractive surgeon (S.G.), under topical anesthesia. Femtosecond laser pulses with a repetition rate of 500 kHz, an energy cut index of 35-37 nJ, and a spot distance of 4.5μ were used, first in a spiral-in pattern to achieve the cut at the deeper plane of intra-stromal lenticule, followed by spiral-out laser for superficial cut. The lenticule diameter (optical zone) was 6.0 to 6.5 mm, side-cut angle: 90° cap diameter was 7.5mm, and cap thickness of 100μm. A superior 2 mm incision was created by the femtosecond laser to provide access to lenticule and allow its extraction.

Following creation of lenticule, the incision was opened, and the two planes of the lenticule were identified. A thin blunt spatula was used to dissect the superficial and deep planes of the lenticule and to break the remaining tissue bridges, thus separating the lenticule from the surrounding stroma. This lenticule was grasped with a pair of blunt forceps and extracted through the incision.

The corneal interface was subsequently flushed with balanced salt solution. The postoperative regimen included a tapering dose of prednisolone and ofloxacin eye drops 4 times a day for 3 days as well as lubricating eye drops administered 4 times a day for 4 weeks. At follow up visits on days 1 and 15 and at 3 months.

Results- At 3 months, 98.83% of eyes had attained a UCVA of 20/20 or better (Figure 1). No patient had a loss of CDVA, and 37 eyes (2.83%) showed a gain in 1 line in postoperative CDVA (Figure 2).

A scatter plot of the attempted correction versus the actual correction achieved (manifest spherical equivalent) at 3 months after SMILE (Figure 3). All eyes were within ±0.75D of the attempted correction.

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Dr. Sri Ganesh MS, DNB
Dr. Sheetal Brar MS
Refractive results in our study were excellent and comparable to those published by Shah and Vestergaard et al..

Even though 92.67% of the eyes had 20/20 best corrected visual acuity preoperatively, 98.8% of the eyes achieved a UCVA of 20/20 or better following the SMILE procedure. This gain in lines can be attributed to a number of factors: Elimination of the minifying effect of glasses, especially in high myopes and overall high refractive accuracy attributed to reduced changes in stromal hydration intraoperatively. Variation in corneal stromal hydration is the most likely cause for under or overablation of stromal tissue. In LASIK, the flap needs to be lifted before excimer laser ablation can be done, thus exposing the stroma to hydration changes before refractive correction. On the other hand, in SMILE, the refractive lenticule is cut by the femto laser prior to any disturbance of the stroma.

Higher-order aberrations increased from a preoperative mean RMS of 0.258±0.116μm (range, 0.011 to 0.78μm) to 0.31±0.115μm at 3 months postoperatively (p<0.0001), which is less compared to LASIK according to the published literature. Reduced induction of HOAs were observed as a result of good centration achieved during suction. Studies done on LASIK showed an increase of 0.10μm in coma and 0.17μm in spherical aberrations. Kohner et al. found an increase of 0.13μm spherical aberrations.

There was a significant reduction in contrast sensitivity at postoperative day 1, but that improved by day 15 and by 3 months postoperatively and was clinically insignificant for lower spatial frequencies (1.5, 3, and 6 cycles/degree) (Figure 4). These results were comparable with those found in studies with LASIK.

A significant reduction in Schirmer’s 1 and 2 and TBUT were seen from a preoperative mean at 3 months (p<0.001). Similarly, tear osmolarity significantly increased from 308.64mosm/L to 309.37mosm/L (p<0.001; Figure 5).

However, postoperative dry eye was seen with less frequency than that seen following PRK or LASIK. This can be attributed to the small side-cut incision, which means a smaller likelihood of cutting corneal nerves, hence leading to less dry eye postoperatively.

Results of this large series demonstrate good refractive accuracy and safety of ReLEx® SMILE for the treatment of myopia and myopic astigmatism. Postoperative dryness and aberrations and reduction in contrast sensitivity, the accepted drawbacks of any corneal refractive surgery, seem clinically less significant with SMILE.

In conclusion, the future for small incision lenticule extraction appears quite bright and as advances in technology progress, it might replace LASIK in the near future.

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IATROGENIC ECTASIA – PREVENTION & MANAGEMENT

Shreyas Ramamurthy, D. Ramamurthy

Iatrogenic ectasia despite its rarity, remains one the most challenging complications for any refractive surgeon. The actual incidence of iatrogenic ectasia remains undetermined possibly due to under reporting, but previous studies have estimated incidence ranging from 0.04\% to 0.2\%. Better understanding of corneal biomechanics, newer investigative modalities and advances in management strategies have greatly helped in both prevention and management of this dreaded complication. The focus of this article will be to deal with nuances of pre operative screening and to highlight salient points in management of iatrogenic ectasia.

PREVENTION

An essential pre requisite in prevention of iatrogenic ectasia is a good understanding and identification of pre operative risk factors.

Risk Factors

Low Residual Bed Thickness (RBT)

Low RBT has been the most recognized risk factor for iatrogenic ectasia. The cut off value however remains controversial. The initially accepted RBT of 250µ that was put forward by Randleman et al is not a validated safety measure as a number of cases with greater than 250 µ residual bed and some even above 300µ RBT have demonstrated iatrogenic ectasia. Recently reported cases of Post PRK ectasia have all had RBT above 350 µ\(^{1}\). An issue regarding the reporting of RBT is that in a vast majority of published cases the RBT has been calculated rather than measured. This calculation can be erroneous due to variabilities in flap thickness\(^{2,3}\) and stromal ablation. All these factors not withstanding RBT continues to remain the most relevant pre operative risk factor to be kept in mind.

High Myopia, Deep Ablations and lower pre operative corneal thickness have also been put forward as potential risk factors as most cases of early reported cases of ectasia had ablations greater than 8D. These may however be indirectly linked to lower RBT\(^{4}\).

Percentage of Tissue Altered (PTA)

Corneal tensile strength is not uniform throughout corneal stroma, with the anterior sub bowman s stroma having the highest tensile strength and a progressive weakening in the deeper 60%\(^{5}\). Flap thickness factors directly into this alteration, as the anterior lamellar flap does not contribute significantly to postoperative corneal tensile strength\(^{6}\).

There is an integrated relationship between preoperative corneal thickness, ablation depth and flap thickness in determining the relative amount of biomechanical change that has occurred after a LASIK procedure\(^{7}\). Recent publications have focused on the percentage of tissue altered after LASIK procedure as an important pre operative metric in predicting iatrogenic ectasia\(^{8}\). The relation has been described as PTA = (FT + AD)/CCT where PTA = percent tissue altered, FT= flap thickness, AD = ablation depth, and CCT = preoperative central corneal thickness. This metric may more accurately represent the risk of ectasia than the individual components that comprise it. A cut off value of 40% appears to have greater prevalence and higher sensitivity than previous individual criteria like residual bed thickness and moderate and high risk factors of the Enhanced Risk score systems put forward by Randleman.

Tomographic indicators

Almost 40 percent of cases of iatrogenic ectasia reported have had pre operative abnormalities on topography including forme fruste keratoconus. With advancement of imaging technologies and availability of Scheimpflug devices a greater emphasis has been laid on application of various tomographic indices for screening patients for refractive surgery.

Although individual elevation and pachymetric indices have failed to yield a high sensitivity in differentiating keratoconus suspects from normal individuals, the multivariate overall deviation index (D) provided by the Pentacam software taking a cut off of >2.6SD has a high sensitivity approaching 90\% in differentiating normal controls from keratoconus suspects\(^{9}\). Yet they lack specificity and may produce a high false positive rate.

The Galilei dual Scheimpflug analyser also provides important indices like the Cone Location and Magnitude Index (CLMI) and the Kranmann – Arce Index (Posterior asphericity asymmetry index) which provide high sensitivity approaching 93\% in differentiating between normal and keratoconus suspects\(^{10}\).

Despite having such advanced tomographic techniques and their various derived multivariate indices which provide
useful screening criteria, still 10% of subclinical keratoconus could get missed and newer investigative modalities in the horizon may provide further insight.

Spectral Domain Optical Coherence Tomography (SD-OCT)

Recent advances in the field of anterior segment OCT imaging have laid emphasis on mapping the epithelial thickness profile as an important marker for keratoconus. The corneal epithelium is highly sensitive to asymmetries in the shape of the underlying stroma and the reactive hyperplasia of the corneal epithelium can mask the underlying irregularities and may have a significant impact on corneal topographic measurements12.

The epithelial thickness varies considerably from periphery to centre and in keratonic eyes the mean epithelial thickness over the apex of the cone was found to be the thinnest and therefore could be used as an early indicator for detecting subclinical keratoconus which may otherwise be masked due to these epithelial irregularities on tomography13.

Imaging of the Bowman’s layer, which typically undergoes disintegration and variable thinning in keratoconus, is another recent development. Using customized SD-OCT, the Bowman’s layer can be imaged and quantified and its regional variations has been shown to be valuable qualitative and quantitative diagnostic indices for the diagnosis of keratoconus14.

MANAGEMENT

Conservative management in the early form of ectasia is in the form of spectacles and contact lenses. In contrast to keratoconus, iatrogenic ectasia has a greater propensity for progression even at a later age and therefore requires surgical intervention for arresting progression as well as improving refractive outcomes.

Collagen Cross Linking (CXL)

Hafezi et al15 reported the first case series of iatrogenic ectasia which was stabilized with collagen cross linking. The extent of flattening of maximum keratometry achieved after cross linking in iatrogenic ectasia appears to be less than in keratoconus. Theoretically, CXL in post-LASIK eyes is likely to be less effective as CXL typically treats the anterior 300 mm of the cornea, which includes the LASIK flap. The flap affords no biomechanical stability, leaving 200 mm or less of treatment in the residual stromal bed. Reduced riboflavin diffusion in corneas that have had LASIK, as well as an intrinsic difference in the pathophysiology of iatrogenic ectasia and keratoconus, may also account for the less pronounced CXL effect16.

CXL combined with Topography guided Photorefractive keratectomy

Combining a low grade refractive correction and topographic anterior surface normalization along with cross linking is an exciting new avenue, which can be used to treat patients with iatrogenic ectasia. Kanellopoulos and Binder17 used MMC-enhanced
topography-guided transepithelial PRK followed by CXL with hypotonic riboflavin to treat patients with post-LASIK ectasia. The authors used an effective optical zone of 5.5 mm while aiming to correct 70% of the refractive error to minimize tissue ablation. They report topographic stability in all but 2 eyes and an improvement in UDVA in 27 of 32 cases.

This is a suitable modality for mild to moderate keratoconus with centered cones. A minimum thickness of 450u at thinnest point is recommended and the ablation depth is usually restricted to 50u depth (Figure 1&2). As most of the ablation happens within the LASIK flap, there is minimal compromise to biomechanical strength with the additional ablative correction. There was initial controversy about whether the treatment should be done simultaneously or in sequential steps, but that has been put to rest with sufficient literature suggesting that simultaneous treatment has better efficacy as the ablative correction is carried out in a virgin cornea and is likely to be more predictable rather than in a cross linked cornea where in ablation rate may vary and we are removing previously cross linked tissue which is counter intuitive to the treatment itself.

**CXL combined with Intra Corneal Ring Segments (ICRS)**

In more advanced cones with greater than 2 line loss of BCVA and having decentered cones, ICRS offers a viable options in combination with cross linking. A minimum pachymetry of 450u is required at the 6mm zone or the zone of implantation of the ICRS which is usually placed at 70% depth (Figure 3&4). ICRS shortens the arc length and shifts the decentered cone to a more physiologic position in front of the pupil. ICRS have been reported to improve best spectacle and contact lens corrected vision and a reduction in higher order aberrations in greater than 70% of iatrogenic ectasia eyes.

**Phakic Intraocular lenses**

Though originally designed to correct myopia and orthogonal astigmatism, Phakic IOLs are being increasingly used in ectatic disorders as well. Subsequent to cross linking and stabilization of the ectasia and in some cases where necessary after using 1CRS to improve centration of the cone, Phakic IOLs can be used to tackle the residual refractive errors. The minimum time interval that has been advocated for implanting a Phakic IOL after cross linking is 6 months (Figure 5).

**Keratoplasty**

For advanced ectasia where cross linking cannot be performed and unsatisfactory contact lens corrected vision or contact lens intolerance, Deep Anterior Lamellar Keratoplasty (DALK) or Penetrating Keratoplasty (PK) remains the only viable option. Care must be taken to include the full extent of the cone in the trephination to avoid any recurrence of ectasia.

**CONCLUSION**

Though the occurrence of iatrogenic ectasia is infrequent, it can be devastating for both the surgeon and the patient. Careful pre operative assessment of any risk factors and use of newer investigative modalities in screening for sub clinical keratoconus can help in effectively reducing the incidence of iatrogenic ectasia. And when ectasia does occur, early detection and treatment using cross linking combined with other refractive modalities can help in effective visual rehabilitation.

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Annual GBM Announcement

The Annual General Body Meeting of Delhi Ophthalmological Society will be held on August 28, 2016 in Ayurvigyan auditorium, Army Hospital, New Delhi.

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MULTIPLE CRANIAL NERVE PALSY

O
ne of the most common clinical presentations in neuro-ophthalmology involves diplopia due to dysfunction of the ocular motor nerves, cranial nerve III, IV and VI. Acquired cranial neuropathies appear with a limitation of motility corresponding to the appropriate muscle innervated by the involved cranial nerve. The diplopia is worst in the direction of action of the weak muscle. It is essential to carefully evaluate for non isolated ophthalmoplegia in every case of cranial nerve palsy as it may indicate a life threatening underlying pathology.

ANATOMY
The three ocular motor cranial nerves originate as paired brinistem motor nuclei. These nuclei receive input from supranuclear centres to coordinate movement of the eyes. Motor axons traverse the brinistem as fascicles, often passing near structures that can be simultaneously involved with brinistem disease (Figure 1).

The axons exit the brinistem forming a peripheral cranial nerve, passing through the subarachnoid space and cavernous sinus to innervate the extraocular muscles. The anatomy of the cavernous sinus makes it a likely location of lesions resulting in multiple cranial neuropathies. The cavernous sinus consists of a plexus of veins within which is the Vth nerve. The III, IV, V1 and posteriorly V2 lie within its lateral wall. The sympathetic fibres form a plexus along the carotid artery. The pituitary gland lies medially and the optic nerve and chiasm superiorly.1

The superior orbital fissure (SOF) is a narrow bony cleft (3 x 22mm) bounded medially by the lesser wing of the sphenoid, inferiorly and laterally by the greater wing of the sphenoid, and superiorly by the frontal bone. The above structures continue forward into the superior orbital fissure, making it difficult to localize a pathology based on clinical features.

CLINICAL FEATURES
In contrast to isolated mono-neuropathies which are often benign and vasculopathic in nature, involvement of more than one ocular motor nerve rarely results from vasculopathic lesions.2

It is essential to carefully evaluate for nonisolated ophthalmoplegia in every case of cranial nerve palsy as it may indicate a life threatening underlying pathology. Once detected, a detailed systemic and radiological examination is needed to help localize and identify the underlying pathology.

Brainstem lesions large enough to affect the nuclei or fascicles of cranial nerves III, IV and VI in combination cause profound neurologic dysfunction including long tract findings, alterations in consciousness and other cranial neuropathies.

Anatomically, the clinical signs of lesions in the cavernous sinus/SOF region can be explained by the involvement of the respective nerve.3 Lid ptosis is caused by either the involvement of the sympathetic fibers arising from the cavernous sinus, resulting in loss of tone of Mueller muscles, or the involvement of the somatic efferent fibers that course along the superior branch of the oculomotor nerve, resulting in loss of tone of the levator palpebrae superioris muscle.

External ophthalmoplegia occurs due to impairment of the III, IV and Vth nerves.4 Internal ophthalmoplegia arises from disruprion of the parasymmpathetic fibres travelling with the IIId nerve. This paralysis causes dilatation, fixation, and loss of accommodation of the ipsilateral pupil. The pupil can be variably involved, spared or appear spared with a small or mid sized, poorly reactive pupil in case of combined sympathetic and parasymmpathetic involvement.

Injury to lacrimal, frontal and nasociliary nerves results in paresthesia of forehead and upper eyelid, diminished corneal sensation and lacrimal hyposecretion. Proptosis is caused by decreased tone of the extraocular muscles which normally act as globe retractorrs. Associated optic nerve dysfunction and vision loss is suggestive of involvement of the orbital apex.5

Periorbital or facial pain may be a prominent feature due to involvement of the ophthalmic (V1) or maxillary division (V2) of the trigeminal nerve.

Nerve palsies associated with proptosis, chemosis and visual loss often arise in the orbit.

The universal symptom associated with dysfunction of the ocular motor nerves is binocular diplopia worst in the direction of action of the weak muscle. Typically, fourth nerve paresis is associated with a hyperdeviation which increases on opposite gaze and ipsilateral head tilt. Simultaneous unilateral involvement of the third and sixth cranial nerves is usually straightforward to diagnose as their fields of action do nor overlap. Diagnosis of a fourth nerve paresis in the setting of a third nerve palsy is challenging as the eye cannot be adducted. In this situation, the eye is examined carefully for intortion of the globe on attempted downgaze by visualization of a conjunctival vessel near the 12 o’clock limbus. Cranial nerves II to VIII must be individually and specifically evaluated whenever any cranial neuropathy is suspected.

PATHOGENESIS
The cranial nerves can be affected by multiple disease processes along their course (Table 1).

In contrast to isolated mono-neuropathies, ischemia
is an infrequent cause and tumour, inflammation, trauma, and aneurysm are more common.

Toxoplasmosis gondii can present with multifocal CNS lesions and ocular motor deficits in immunocompromised patients. Wernicke’s encephalopathy is a disorder caused by severe thiamine (Vitamin B1) deficiency in alcoholics. The classic triad of presenting features include ophthalmoplegia, mental confusion and gait ataxia.

Meningeal disease, including infectious and neoplastic seeding of the subarachnoid space can result in dysfunction of multiple cranial nerves. Head trauma with presumed shearing of multiple cranial nerves and base of the skull tumours can also present with a similar picture.

The sixth nerve crosses along the petrous apex and a syndrome of sixth nerve palsy, facial pain, hearing loss and facial palsy can occur as a result of mastoiditis, tumour, trauma or aneurysm of the internal carotid artery. This is known as Gradenigo’s syndrome.

Broad categories of diseases that involve the cavernous sinus include neoplasms, inflammation, infection, vascular lesions and trauma. Cavernous sinus and SOF lesions may present with identical clinical features including third nerve paresis, fourth nerve paresis, sixth nerve paresis, Horner’s syndrome and sensory loss of the first division of trigeminal nerve. There may be involvement of the second division of the fifth nerve if a lesion is in the posterior cavernous sinus. This constitutes the cavernous sinus syndrome.

Pituitary apoplexy is a clinical syndrome caused by acute haemorrhage in a pituitary tumour. This causes a rapid onset of combined often bilateral cranial neuropathy with headache and loss of vision. Endocrine insufficiency and coma can occur from haemorrhage into the subarachnoid space.

Tolosa-Hunt syndrome (THS) refers to a condition of unknown cause causing painful ophthalmoplegia resulting from granulomatous inflammation within the cavernous sinus or orbital apex (Figure 2). The diagnostic criteria for THS includes episodes of unilateral orbital pain persisting for weeks if untreated, associated paralysis of one or more of III, IV or VIth cranial nerves and/or demonstration of a granuloma by MRI or biopsy. THS is a diagnosis of exclusion made after excluding other causes of painful ophthalmoplegia. THS may have a relapsing and remitting course.

Infectious diseases involving the CNS, paranasal sinuses and periorbital structures can present with sudden onset painful ophthalmoplegia. Mucormycosis and Aspergillosis mainly occur in predisposed patients with diabetes mellitus, alcoholism and immunosuppression. Otolaryngologic evaluation may be helpful as an indicative eschar is seen in the nose.

Iatrogenic causes include sinonasal and periorbital surgical procedures. Optic neuropathy can also occur due to direct or indirect injury to the optic nerve. Blunt or penetrating orbital trauma can lead to SOF Syndrome.
or Orbital Apex Syndrome (Figure 3).

Vascular causes include cavernous carotid aneurysms, cavernous sinus thrombosis, direct carotid artery to cavernous sinus fistula and dural arteriovenous fistula. Cavernous carotid artery aneurysms can cause a unilateral or bilateral cavernous sinus syndrome via compression of adjacent cranial nerves. A direct carotid cavernous fistula forms as a result of trauma and causes a cavernous sinus syndrome, headache, facial pain, severe proptosis, chemosis and glaucoma from elevated episcleral venous pressure. A less serious dural arteriovenous fistula can occur spontaneously in a setting of long standing hypertension or connective tissue disorders. They present with a more subtle clinical picture with cranial neuropathies, proptosis, orbital bruit and conjunctival injection.

Bilateral ophthalmoplegia is a unique variant of multiple cranial nerve palsies with involvement of at least one cranial nerve on each side. This implies a lesion that is large enough to cause deficits bilaterally or is situated in a location such that bilateral cranial nerves are involved.

Complete bilateral ocular paralysis (Figure 4) is a rare condition which may be caused by polyneuropathy, brainstem lesions, impairment of neuromuscular transmission and lesions of cavernous sinus and orbits. Guillain-Barre is a collection of clinical syndromes that manifests as an acute inflammatory demyelinating polyradiculoneuropathy, usually demyelinating and follows a relatively mild respiratory or gastrointestinal illness. Miller Fisher syndrome is a rare variant characterized by areflexia, ataxia and ophthalmoplegia, with nearly 30% of patients developing bilateral complete ophthalmoplegia.
EVALUATION AND MANAGEMENT

The patient with multiple ocular motor nerve palsies should be carefully evaluated neurologically, ophthalmologically and systemically for associated features to help localize and identify the underlying pathology.

Neuroimaging of the brain, cavernous sinus and orbits is required when multiple simultaneous cranial neuropathies are present. High resolution (1.5 T or higher) MRI is the preferred imaging modality where contrast and fat suppression sequences of the brain and orbit are performed. A magnetic resonance angiography (MRA) or CT angiography may be required to diagnose a vascular lesion of the cavernous sinus.

Extensive laboratory testing to rule out inflammation and specific infection are necessary especially before steroid therapy. These may include complete blood count with differential, Erythrocyte sedimentation rate, rapid plasma reagin, MHA-TP, serum ACE, C-ANCA, P-ANCA, ANA, PPD, chest radiography, and HIV. CSF analysis is indicated to identify pathologies in the subarachnoid space.

Differential diagnosis including myasthenia gravis, Grave’s disease and inflammatory orbital pseudotumour which can produce complex ocular motility disturbances should be considered.

Management of multiple ocular motor nerve palsies depends entirely on the underlying pathology. Treatment of neoplastic and infectious diseases depends on the nature of the process and its location. The THS is exquisitely sensitive to corticosteroids – pain and ophthalmoplegia resolve rapidly with 60-80 mg/day of prednisone. Direct carotid cavernous fistula are treated by balloon occlusion of the connection between the carotid artery and cavernous sinus.

Aside from treatment for the specific cause, the symptoms of diplopia must be treated. Occlusion of either eye with a patch or opaque tape over glasses is the best temporary treatment. Prism therapy is helpful in chronic, constant, small deviations especially when not very incomitant.

Botulinum toxin can be useful in selected cases of IV or VIth nerve paresis to promote fusion and prevent contracture.

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Financial Interest: The author does not have any financial interest in any procedure/product mentioned in this manuscript.
Aberrant facial nerve regeneration (AFR) following facial nerve palsy may cause facial nerve synkinesis and ptosis. The latter is usually because of increased orbicularis tone and increases with synkinetic orofacial muscle contraction. These patients may be referred for ptosis surgery without recognition of the causal AFR or even a past history of facial nerve palsy.

A 36 year old female presented with watering from left eye while eating drooping of left upper eyelid and off and on pain around left eye for the past two years. She was apparently well about 2 years ago when she developed acute onset left sided facial palsy about a month following enteric fever. During the episode there was difficulty in eating and drinking, drooling of saliva, pain around the jaw, impaired speech and mild lagophthalmos. There was no H/o altered taste, impaired sensations over left half of face, chronic ear discharge or pain, no impairment of higher functions, associated limb weakness, preceding trauma or surgery. After about a month, the facial palsy recovered but patient noticed, watering from left eye while eating which was more so with salty and sour food like pickle. There was drooping of left upper lid which was insidious in onset and non- progressive in nature (Figure 1). Variability in ptosis was noted while eating and also with various orofacial movements but not with exercise or fatigue. She also had mild to moderate left sided off and on periorbital pain, redness and foreign body sensation in both eyes but there was no H/o diminution of vision, discharge, limitation of eye movements, diplopia or any other ophthalmic complaints in either eye. Past and family H/o were not contributory.

General physical examination and systemic examination were essentially normal including all cranial nerves except cr.n.VII. On ocular examination, BCVA was 6/6 in BE, near vision N6 BE with normal colour vision. Retinoscopy done at 2/3rd metres with tropicamide 0.8% and phenylepherine 5% was +2.00 D in both meridians in BE. Facial symmetry was normal except for left eye mild ptosis with reduced MRD1 and MRD2. LPS excursion was good with good bell’s phenomenon in BE. Ocular motility in both eyes was normal with normal anterior and posterior segments. Schirmer’s test showed moderate to severe dryness in BE while after gustatory stimulus, increased wetting of schirmer’s strip was noted in left eye as compared to right eye.

On examination, we noted increased watering from left eye while eating. Also, there was movement of both lids of left eye while eating which was more so with side to side movements. We also noted increase in the ptosis of LUL with closing of mouth and moving to the affected left side while the aperture returned to normal on opening the mouth and moving to the opposite side. But when we examined the patient closely, we found that there was increase in the amount of ptosis and decrease in the palpebral aperture of left eye with various orofacial movements like pursing of lips (Figure 2), puffing of cheeks, movement of mouth towards left rather than with jaw movements. We also noted dimpling of the chin which occurred with closure of the eyes. Synkinesis assessment questionnaire (SAQ) was also administered to the patient in which the sum of scores came out to be ten. Investigations were done to rule out other causes of facial palsy which showed normal blood profile and counts, MRI brain with orbits showed normal facial nerve anatomy with pansinusitis. So, we arrived at a diagnosis of Left sided facial synkinesis with mild ptosis with moderate to severe dry eyes.

CONCLUSION

Ptosis of LUL in our patient is because of increased orbicularis tone, as both the MRD1 and MRD2 were decreased in the left eye which is typically seen in a case of facial synkinesis. In our patient we noted two types of synkinesis i.e. secretomotor synkinesis (crocodile tears or Bogorad’s syndrome) in which eating of food resulted in increased watering from left eye and motor synkinesis in which various orofacial movements led to increase in ptosis and decrease in palpebral aperture of the left eye. A Reverse synkinesis type of picture was also seen in the patient in which closure of eyes led to dimpling of the chin. SAQ would help in the assessment of residual synkinesis in further follow up visit (Figure 4).

DISCUSSION

Facial synkinesis is a sequelae of facial palsy and result from miswiring of nerves after trauma manifested through involuntary muscular movements accompanying voluntary movements. Most common symptoms are involuntary eye closure with volitional contraction of mouth muscles, midfacial movements with volitional eye closure, neck tightness (Platysmal contraction) with volitional smiling and hyperlacrimation (also called Crocodile Tears). There

Niharika, Taru Dewan, Praveen Kumar Malik, Ashok Pathak, K. Govekar, Pradeep Aggrawal

MONTHLY MEETING KORNER
are three proposed mechanisms for synkinesis: Aberrant Nerve Regeneration, Interneuronal Ephaptic Transmission, and Nuclear Hyperexcitability. Aberrant nerve regeneration (AFR) of facial nerve is the most widely accepted mechanism for synkinesis. The hypothesis states that after trauma, axons project from the facial nucleus to incorrect peripheral muscle groups. These aberrant branches can simultaneously innervate different subdivisions of the facial nerve. For example, a lesion in the facial nerve branch supplying the orbicularis oris leads to degeneration of the axons. Regeneration of axons from the lesion site begins when half of the regenerating axons aberrantly branch off and innervates the orbicularis oculi (eye muscle). Thus, various oro-facial movements lead to involuntary closure of the eye in the affected side. Crocodile tears result from misdirection of regenerating parasympathetic secretomotor fibres of facial nerve supplying salivary gland to lacrimal gland. Management options for facial synkinesis includes Neuromuscular training, Biofeedback therapy, BOTOX (Botulinum toxin-A) and surgery. Surgery was not advised due to unpredictable results. Due to the temporary effects of inj. botox (3-4 months) and need for repeated injections, this option was also declined by the patient. Also, inj. of botox into lacrimal gland for relieving crocodile tears would aggravate the already existing dryness of eyes. Facial retraining teaches techniques for increasing wanted movements while focussing on restricting unwanted movements; very successful in decreasing synkinesis in about 60-70% cases after 7 months. Mirror biofeedback provide feedback on muscle movements thereby reducing synkinesis. Meme therapy includes massage, stretching exercises, exercises to promote symmetry of the face at rest and during movement and control synkinesis. The patient has benefitted from facial retraining and is managing her social life comfortably.

SYNKNESIS ASSESSMENT QUESTIONNAIRE (SAQ)

<table>
<thead>
<tr>
<th>Questions Asked</th>
<th>Score from 1-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>When I smile, my eye closes</td>
<td>0</td>
</tr>
<tr>
<td>When I speak, my eye closes</td>
<td>0</td>
</tr>
<tr>
<td>When I whistle or pucker my lips, my eye closes</td>
<td>5</td>
</tr>
<tr>
<td>When I smile, my neck tightens</td>
<td>0</td>
</tr>
<tr>
<td>When I close my eyes, my face gets tight</td>
<td>0</td>
</tr>
<tr>
<td>When I close my eyes, the corner of my mouth moves</td>
<td>0</td>
</tr>
<tr>
<td>When I eat, my eye waters</td>
<td>5</td>
</tr>
<tr>
<td>When I move my face, my chin develops a dimpled area</td>
<td>0</td>
</tr>
</tbody>
</table>

Sum of Scores = 10

SAQ Total Score = 10/45 x 100 = 22.22%

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Phacoemulsification surgery is evolving dramatically with each passing day. In terms of surgical technique for mature hard and suprahard cataract, the nucleus removal portion of the procedure continues to be rapidly refined, aiming for improved safety and efficiency. Hard cataracts pose a challenge to phaco surgeons due to negligible cortical and epinuclear buffering material. The nucleus essentially sits on the weak, fragile and thin posterior capsule such that the capsular bag is always at the risk of disruption.

Nuclear fibres are tight, thick, sclerosed and densely packed at the poles making the nucleus very bulgy, hard, leathery and unbreakable at the centre. (Figure 1) However, while passing through the equator these fibres are sparsely arranged. Hence the nucleus is comparatively soft and thin, having prominent natural cleavage planes between the fibres at the equator (Figure 2). As a result of this anatomical arrangement, it’s always easier to achieve a natural cleavage plane between the lens fibres at the equator rather than at the centre of the nucleus.

Greatest challenge is to achieve full thickness nuclear division to initiate the nuclear emulsification. Physically hard, mature cataracts are identical to solid hard rocks- stronger in compression but weaker in tensile strength. It’s relatively easier to split or pull apart these hard rocks than to compress, chop, sculpt or fracture. Similarly to achieve full thickness nuclear segmentation it’s fundamentally better to apply lateral separation or dispersive forces instead of compressive forces, at the point of natural weakness along the cleavage plane between the lens fibres.

Techniques that are currently used, such as Divide and Conquer described by Gimbel1, and Stop and Chop made popular by Koch2, attempt nuclear segmentation at the thick, bulky and dense central nucleus after sculpting a large, deep and wide central trench. This requires excessive and longer duration of phaco power to create the trench and extensive manipulation to divide the nucleus and yet fails to achieve full thickness nuclear and epinuclear segmentation in hard mature cataracts in many cases.

To achieve full thickness nuclear division Dr. Kunihiro Nagahara3 introduced his original nuclear chopping technique in 1993, which created a new landmark in phaco cataract surgery and changed the entire concept of phacoemulsification techniques. Nagahara’s phaco chop technique- recently classified as horizontal chop4 by Dr David Chang, has made cataract surgery more efficient and safe.

Chopping techniques are so named because they are analogous to chopping wood along a cleavage plane. Similarly Nagahara’s phaco chop technique utilizes mechanical forces to chop and segment the nucleus, thereby replacing the ultrasound power otherwise needed to sculpt the nucleus for segmentation. Nagahara’s technique involves impaling the phacoemulsification probe tip, deep into the center of the nucleus towards posterior capsule to stabilise the nucleus. Chopping instrument is then passed under the distal edge of the anterior capsulotomy and around the lens equator. The tip of the chopper is then drawn through the lens nucleus towards the phaco handpiece in the horizontal plane, cleaving the lens. At the centre of the nucleus the phaco tip and chopper are then separated laterally, to break the nucleus into two pieces. The nucleus is then rotated 90 degrees, and the same procedure is performed on each of the hemi nuclei. The nucleus is broken into four or more pieces, depending on the density of the lens (more pieces for denser lenses). The lens fragments are then emulsified and removed.

Hence we see that the Classical Nagahara’s phaco chop technique primarily utilizes mechanical forces to chop and segment the nucleus, thereby replacing the ultrasound power otherwise needed to sculpt the nucleus. However, drawing the chopper from the equator while incising the lens fibres over a longer distance is often difficult, resulting in formation of an uneven cleavage plane. Uneven cleavage plane results in misdirected vector forces, which cause rotation of the nucleus, making it further more difficult to incise the nucleus leading to incomplete nuclear segmentation.
Nagahara’s chop also utilizes compressive forces deep at the strongest central nucleus that attempts splitting of the dense hard central nucleus after drawing the chopper from equator towards the phaco tip impaled near the centre of the nucleus. Nagahara’s chopping technique though a popular technique still has the problems of incomplete splitting and increased manipulations as dividing the hard central nucleus in hard mature cataract is difficult and often results in incomplete nuclear segmentation. Incomplete nuclear division along with conjoined segments leads to unnecessarily prolonged manipulation with excessive use of phaco energy.

We describe a new surgical technique, ‘Terminal chop’ that allows a successful full thickness nuclear division in a hard nucleus through the posterior plate in 100 per cent of the attempted cases, with ease and safety. This technique is very simple and effective in utilizing the advantage of unique mechanical forces to split the nucleus. Mechanical forces utilised in Terminal chop unfolds a whole new dimension in the mechanics of nuclear segmentation.

In Terminal chop instead of compressive forces, a dispersive mechanical force is used at the thinnest and weakest equator of the nucleus. Without penetrating deep into the centre of the nucleus, phaco probe achieves firm hold of the nucleus within the equator adjacent to blunt chopper which is hooked around the equator of the nucleus. Lateral separation force initiated at the equator simply traverses through the entire nucleus and results into full thickness nuclear segmentation including the posterior plate.

Terminal chop is very simple, safe and effective surgical technique utilizing the advantages of unique mechanical forces segmenting the entire nucleus into two clean halves with minimum use of ultrasound energy and least manipulation within the capsular bag.

**TECHNIQUE**

The cataract was graded according to the Lens Opacities Classification System III (LOCS III)\(^5\) and eyes with Nuclear Opalescence (NO) grade IV, V and VI were included for Terminal Chop phaco surgery. All eyes had a corneal endothelial cell count greater than 1500/mm\(^2\). Eyes with previous trauma, inflammation, intra-ocular surgery or pathology, were excluded. All patients signed an informed consent for the procedure.

Eyes were dilated with tropicamide 0.8 % and phenylephrine 5% eye drops. Topical anaesthesia (proparacaine 0.5%) was used for all cases. Balanced salt solution (BSS) was used for irrigation. In all cases a 2.2 mm, temporal, anterior limbal, near clear corneal main incision was made. Viscoelastic (Healon GV, Abbott Lab Inc, Illinois) and viscodispersive (Viscoat, Alcon Inc, Fort Worth, TX) was injected using a Soft-shell technique[6]. In all our surgeries, 0.06 % trypan blue dye was used to stain the capsule for better visualisation.

WHITE STAR Signature Phacoemulsification system (Abbott Labs Inc, Illinois, USA) with FUSION fluidics and ELLIPS FX technology was used in all cases. Mini-flare phaco tip of 0.9 mm outside diameter and 15 degrees angled tip was used. Parameter settings ranging from 40% to 50% maximum power with 3 pulses, 500 mmHg maximum vacuum, 50 ml/min aspiration flow rate were used. Simultaneous blending of longitudinal and transversal tip motion was used for sculpting and quadrant removal, in all the cases.

**SURGICAL STEPS**

After the routine incisions the anterior capsule is stained with trypan blue dye under air bubble to enhance the visibility. In accordance with soft shell strategy the dispersive OVD- Viscoat, is
injected into the anterior portion of the anterior chamber following which the anterior capsule is flattened with the injection of cohesive OVD- Healon GV, over it.

A large capsulorhexis with an intended 6.0 mm diameter is made using Utrata capsulorhexis forceps. Hydrodissection is accomplished using a disposable hydrodissection cannula and confirmed by rotating the nucleus to ensure that it is totally free inside the capsular bag. Minimal hydrodissection is attempted so as to avoid posterior capsule rupture due to sudden rise in intracapsular pressure, as the capsule in mature cataracts is already fragile due to distended large nucleus.

We recommend the use of a specially designed (Rajendra Prasad) angulated blunt chopper with a smooth olive tip. This enables firm grip and safe manipulation of the lens equator with no threat to the posterior capsule (Figure 3).

Once the hydrodissection and rotation is complete, a short superficial central trench of 1 mm x 1 mm x 1 mm is sculpted in the nucleus sufficient to hold and engage the phaco tip (Figure 4). This manoeuvre requires very less phaco energy than expected, as the trench is very short and shallow.

Using the hyper pulse or burst mode with high vacuum settings the phaco tip is then engaged at the distal end of the trench (Figure 5) and impaled into the nucleus, keeping the tip directed towards the equator parallel to the pupillary plane within the superficial layers of the nucleus to achieve a firm grip at the periphery just within the equator of the nucleus (Figure 6).

While the nucleus is firmly held in position with the phaco tip, equator of the nucleus is slightly lifted vertically and brought out at the capsulotomy edge (Figure 7). Blunt chopper is then very simply passed around the lens equator by sliding the chopper into the space created within the capsulotomy edge to hook and engage the nucleus (Figure 8).

The blunt chopper is then drawn just 1.5-2 mm into the thin and softer terminal edge of the nucleus, to create a small full thickness nick adjacent to the phaco tip, simultaneously achieving a firm hold of the nucleus without any horizontal excursion of the chopper (Figure 9). The force vector of 90 degrees lateral separation is then initiated and continued until the entire nucleus is split from the equator to equator through the centre into two complete clean halves (Figure 10).

Direction of splitting follows the natural cleavage plane through the lens fibres, which courses from equator to equator through the center of the lens nucleus. The initial full thickness terminal fracture traverses through the entire nucleus, propagating a full thickness tear from equator to equator through...
the centre, segmenting the entire nucleus along a clean cleavage plane between the lens fibres.

Once complete nuclear division is achieved the nucleus is then rotated 90 degrees, and the same procedure is repeated to further chop the nucleus into multiple fragments depending on the density of the lens. The lens fragments are then comfortably emulsified and aspirated.

Though there may not be much of residual cortex in these mature hard cataract we still find cellular residue which needs to be aspirated from the fornices by holding the anterior edge and stripping off from the capsular bag.

A single piece hydrophobic acrylic IOL is injected into the capsular bag after inflating the bag with a cohesive OVD. We can appreciate a well centered lens in the capsular bag with uniform anterior capsular ring on the IOL optic.

**DISCUSSION**

A myriad of techniques have been tried and tested with inconsistent results for managing hard nuclei that are emulsified in the anterior chamber, in the plane of iris, or in the posterior chamber. Nuclear segmentation in these cases is often incomplete, creating problems for the surgeon leading to unnecessary manipulation, use of excessive phaco energy and subsequent unsatisfactory postoperative results.

Although Nagahara's phaco chop technique, which mainly utilizes mechanical forces to chop and segment the nucleus in place of ultrasound power otherwise needed to sculpt and segment the nucleus, has shown certain fallouts when tackling mature hard cataracts. The incomplete nuclear segmentation is a common problem, and requires more manipulation with the chopper leading to formation of an uneven cleavage plane cutting through the lens fibres over a longer distance. While bringing the chopper towards the phaco tip which is impaled near the centre of the nucleus, misdirected vector forces often lead to rotation of the nucleus, making it difficult to incise it, thereby resulting in incomplete splitting of the nucleus.

Impaling the centre of the nucleus to achieve a firm hold for successful chopping is fairly difficult. Very often we do not get the proper depth of the phaco tip buried into the hard nucleus resulting in an inappropriate cleavage plane. It's always challenging to place the sharp chopper under the capsular rim and around the equatorial nucleus without direct visualisation.

Because of these fallouts, the original Nagahara's chop underwent tremendous modification and evolution with different variations of chopping technique like Drill-and-crack7 technique for nuclear disassembly of hard nucleus, Half-moon supracapsular nucleofractis phacoemulsification8 and Crater-and-chop9 technique for phacoemulsification of hard cataracts that were introduced by varios authors. However, we still find it difficult to achieve full thickness nuclear division and cracking while operating on mature hard cataracts, leading to unnecessary prolonged manipulation and excessive use of phaco energy to emulsify the nucleus.

The Terminal Chop technique enables us to obtain a complete full thickness nuclear segmentation including the posterior plate in first attempt, with minimal horizontal excursion of the chopper with ease in all cases of hard mature cataracts. This technique has several advantages over the other
techniques that are currently used.

The mechanics behind this technique is quite analogous to tearing a fabric neatly along a cleavage plane within the parallel fibres. This requires an initial nick at the terminal edge of the fabric followed by closely holding the two edges of the fabric and applying lateral separation force to split the fabric into two complete segments.

Consonant to tearing a fabric, in terminal chop a full thickness nick is given at the soft and thin equator of the nucleus with a blunt chopper. Both the edges of the initial nick are firmly held with both blunt chopper and phaco tip which is already impaled and positioned at the equator. Lateral separation of both the instruments create a unique vector force which tear the full thickness initial nick from equator to equator through the centre, segmenting the entire nucleus along a clean cleavage plane between the lens fibres. Unlike in classical Nagahara’s chop, in this technique, a short central trench of phaco tip diameter depth and width is created to engage and impale the nucleus directed towards the equator, parallel to the pupillary plane, to achieve a firm hold at the periphery of the nucleus.

A blunt tipped chopper is then engaged around the thin and softer peripheral nucleus and while drawing the chopper into the nucleus, a small full thickness nick adjacent to the phaco tip is created, while simultaneously achieving a firm hold of the nucleus without any horizontal excursion of the chopper.

As the distance between the phaco tip impaled in mid-periphery within the equator of nucleus and the engaged chopper is very less, a controlled lateral separation of both the instruments create a unique vector force which tear the full thickness initial nick from equator to equator through the centre, segmenting the entire nucleus along a clean cleavage plane between the lens fibres.

The concept of terminal chop technique evolved with extensive clinical experiments performed on the extracted hard nuclei procured from the extra capsular cataract surgery in our clinical set up. Division of nucleus was only possible after holding the equator of the nucleus with phaco probe and blunt chopper adjacent to the initial nick.

Terminal chop takes the advantages of anatomical configuration of crystalline lens, which is relatively soft and narrow at the equator. This is due to the unique arrangement of lens fibres which extend from the posterior to the anterior pole while crossing a plane passing through the equator. Fibres are very densely packed at the poles making the nucleus very bulky, hard leathery and unbreakable at the centre. But while passing through the equator these fibres are sparsely arranged, making the nucleus weak, thin and soft with wide cleavage plane at the equator. Hence it’s always easy to achieve a natural cleavage plane between the lens fibres by initiating the tear at the equator rather than penetrating deep into the centre of the nucleus.

The unique mechanics utilized in Terminal Chop is based on, and makes full use of:

A. **Principle of breaking a rock**
   “Don’t compress, split the hard object along the natural cleavage plane”

B. **Structural configuration of lens with unique anatomical arrangement of lens fibres**
   “Find the weakest natural point of lens that is equator to initiate the division of nucleus”

C. **Mechanics of tearing a fabric**
   “Initiate the split with small nick at the edge of object”

**CONCLUSION**

Terminal Chop technique is an absolutely new and different surgical technique utilizing the advantages of unique mechanical forces to achieve full thickness nuclear segmentation including the posterior plate in hard mature cataract. The mechanics utilised in this technique is highly efficient and safe, unfolding a whole new dimension in the history of phaco cataract surgery.

Terminal chop technique exploits the advantage conferred by natural cleavage plane between the lens fibres at the equator of the lens and ensures a complete nuclear segmentation including the posterior plate from equator to equator through the centre in first attempt itself, in 100% of the attempted cases.

Complete nuclear segmentation achieved with terminal chop propagate a quick and safe nuclear fragment emulsification with least manipulation and minimal use of phaco energy, resulting in exceedingly satisfactory postoperative results.

Terminal chop has several advantages over other techniques currently used to ensure less endothelial cell loss and less postoperative inflammation, leading to a faster recovery and maximal visual rehabilitation.

The crux of Terminal Chop is:

1. *Don’t go deep, stay superficial*
2. *Hold the nucleus at the equator, not deep at the posterior pole*
3. *Don’t use compressive forces. Split the nucleus with dispersive force*

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**Financial Interest:** The authors do not have any financial interest in any procedure/product mentioned in this manuscript.
**Approach to a Patient of Exogenous Endophthalmitis and Management Protocol**

Bhuvan Chanana, Vinod Kumar, Sudhank Bharti

Endophthalmitis is defined as intraocular inflammation predominantly involving the vitreous cavity (leading to exudation in vitreous cavity) and anterior chamber commonly as a result of intraocular colonization by micro-organisms. Contiguous ocular structures such as retina or choroid may be involved.

Exogenous endophthalmitis is classified as:

a) Postoperative.

b) Posttraumatic.

c) Bleb associated.

d) Miscellaneous e.g., suture related, microbial keratitis, infectious scleritis

The organisms most commonly involved in various types of Endophthalmitis are:

**Post cataract surgery**

- Coagulase-negative Staphylococcus (33-77%) from the natural conjunctival flora. The single most common cause of exogenous endophthalmitis is Staphylococcus epidermidis, which is also normal flora of the skin and conjunctiva.
- Staphylococcus aureus
- Streptococci species
- Gram negative bacteria

**Delayed onset (chronic) post cataract**

- Propionibacterium acnes
- Staphylococcus epidermidis
- Candida

**Post glaucoma surgery (associated with filtering blebs)**

- Streptococcus species
- Staphylococcus epidermidis
- Haemophilus influenzae

**Post traumatic**

- Staphylococcus epidermidis
- Bacillus species
- Streptococcus species
- Fungi

Endophthalmitis is defined as intraocular inflammation predominantly involving the vitreous cavity (leading to exudation in vitreous cavity) and anterior chamber commonly as a result of intraocular colonization by micro-organisms. Contiguous ocular structures such as retina or choroid may be involved with an estimated incidence of 0.07% to 0.13%. Three forms of clinical presentation of post-operative endophthalmitis can be distinguished:

a. Severe acute form, usually fulminant, occurs within 1-4 days after surgery, most commonly due to Staphylococcus aureus, Streptococci species, Serratia marcescens, Pseudomonas and Proteus species.

b. Mild sub-acute form, slowly developing, occurs 7-14 days after surgery due to Staphylococcus epidermidis, Coagulase negative cocci.

c. Chronic or delayed form, occurs 4 weeks or more after surgery, due to Propionibacterium acnes

**Clinical Presentation**

- The presenting symptoms and signs of Endophthalmitis are:
  - Decrease visual acuity (Most Common)
  - Pain (pain may be absent)
  - Photophobia
  - Anterior chamber reaction +/- Hypopyon (Figure 1)
  - Reduced or absent fundal glow (Figure 2)
  - Vitritis, Exudates over retina
  - Corneal edema
  - Others: lid swelling, discharge, conjunctival hyperemia, chemosis.

Eye lids and conjunctiva are main source of infection in post operative endophthalmitis and other sources are lacrimal drainage system, infected socket in contralateral prosthetic eye, contaminated surgical instruments, irrigating fluids, eye drops etc.

**Diagnosis**

Diagnosis of endophthalmitis is mainly clinical. Delay in diagnosis is not uncommon (due to use of steroids, associated complications, expected post-operative inflammation). Ultrasonography is an aid, but sometimes can be misleading. Ultrasonography helps to diagnose and monitor response to treatment, to detect retinal detachment and presence of any retained lens matter (nuclear fragment) which may lead to an exaggerated reaction.

Media clarity can be classified depending on the grade of severity of endophthalmitis:
Grade 1: Good glow (visual acuity 6/12)
Grade 2: Can visualize second order retinal vessels (visual acuity < 6/12)
Grade 3: Some retinal vessels visualized hazily
Grade 4: Faint glow but retinal vessels not seen
Grade 5: No glow, red reflex absent

Differential diagnoses of post operative endophthalmitis should be considered:
- Toxin anterior segment syndrome (TASS) [Table 1]
- Complicated, prolonged surgery

Table

<table>
<thead>
<tr>
<th>Signs and Symptoms</th>
<th>TASS</th>
<th>Infectious Endophthalmitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset</td>
<td>12-24 hours usually</td>
<td>2-7 days usually</td>
</tr>
<tr>
<td>Pain</td>
<td>Usually none but can be mild to moderate</td>
<td>Usually severe</td>
</tr>
<tr>
<td>Intraocular pressure</td>
<td>May increase suddenly</td>
<td>Usually not elevated</td>
</tr>
<tr>
<td>Anterior chamber inflammation</td>
<td>Moderate-to-severe anterior chamber reaction with increased white blood cells and fibrin. Hypopyon may be noted</td>
<td>Moderate-to-severe anterior chamber reaction. Fibrin is variable. Hypopyon often present (75% of the time)</td>
</tr>
<tr>
<td>Vitritis</td>
<td>Very rare</td>
<td>Always present</td>
</tr>
<tr>
<td>Lid swelling</td>
<td>Usually not evident</td>
<td>Often present</td>
</tr>
<tr>
<td>Visual acuity</td>
<td>Decreased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Response to steroids</td>
<td>Dramatic improvement</td>
<td>Equivocal</td>
</tr>
</tbody>
</table>

- Preexisting uveitis
- Retained lens material
- Associated ocular injury with inflammation

**Note:** In the presence of significant vitritis, always err on the side of infectious endophthalmitis, until proven otherwise.

**MANAGEMENT**

Vitreous samples should be obtained to isolate the causative organism. Vitreous is the most important source (highest yield rate, 60 to 70%) to know the causative organisms. Vitreous tap can be done using a 23 gauge needle.

The needle is passed through pars plana and 0.2ml of undiluted vitreous is withdrawn. Aspiration may not provide adequate sample as vitreous is denser and contain inflammatory membranes in Endophthalmitis. There is also a risk of retinal detachment. Vitreous biopsy using a vitrectomy probe is a safer method and places less traction on the inflamed and fragile retina. Aqueous may also be cultured but the yield is lower as compared to the vitreous.

**Culture and Laboratory evaluation of intraocular specimens:** Vitreous specimens should be promptly inoculated directly onto culture media. Drops of the sample should be placed onto blood agar (aerobic medium), Sabourauds agar, chocolate agar and thioglycolate broth.

In chronic post operative endophthalmitis the anaerobic culture is kept for 2 weeks as P. acnes takes longer to grow. One drop of vitreous sample placed on clean slides for Gram and Giemsa stains and KOH mount for bacteria and fungi.

**Endophthalmitis Vitrectomy Study (EVS)** recommended:
- Vitreous tap + anterior chamber sampling + intravitreal antibiotics - in cases vision ≥ hand movements at 2 feet.
- Vitrectomy + intravitreal antibiotics in cases with vision < hand movements.

According to EVS systemic

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Figure 1: Slit beam examination shows hypopyon in a case of Endophthalmitis.
Figure 2: Vitreous exudates with poor glow in Endophthalmitis.
antibiotics did not appear to have any effect on the course and the outcome of Endophthalmitis. However, the cases included in EVS study were patients who developed endophthalmitis within 6 weeks after cataract surgery with primary IOL implantation or secondary IOL implantation.

Most commonly used drugs for Intravitreal injection are:
- Vancomycin 1 mg in 0.1 ml - broad-spectrum activity against most gram positive species (is active against MRSA), has become an agent of choice
- Ceftazidine 2.25 mg in 0.1ml – covers gram negative bacilli including Pseudomonas.
- Gentamicin 1mg in 0.1ml was used, but was found to be associated with macular infarction.
- Amikacin 0.4mg in 0.1ml (4 times less retinal toxicity than gentamicin)- Amikacin covers large number of gram negative organisms and those resistant to other aminoglycosides.
- Anti-fungal drugs (in cases with suspected fungal etiology)
  - Amphotericin B 5-10 μg/0.1 ml
  - Fluconazole 25 μg/0.1 ml.

EVS stated no role of systemic antibiotics in post-operative endophthalmitis. However, the role is limited and should be individualized depending on case. Systemic antibiotics may be given in certain cases like:
- Severe fulminant postoperative cases
- Traumatic Endophthalmitis especially when associated with intraocular foreign body
- Associated corneal abscess
- Associated sclera buckle infection, infectious scleritis, proptosis, loss of extraocular movements
- Elevated body temperature or leukocyte count with endophthalmitis
- Ciprofloxacin when given orally shows excellent intraocular penetration. Newer fourth generation fluoroquinolones such as moxifloxacin have also been shown to readily penetrate into the vitreous cavity when administered systemically and achieve MIC values.

**Role of steroids in Endophthalmitis**

In Endophthalmitis there is intense inflammatory response and toxins are released by bacteria. Systemic (oral) steroids are recommended to reduce inflammation in exogenous Endophthalmitis. Steroids do not have any negative effect on the infection course. Topical steroids may also be given if cornea is not involved by infectious process.

**SURGICAL INTERVENTION**

Indications of vitrectomy are:
- Visual acuity < Hand Movements
- Endophthalmitis associated with RD, RIOFB
- Endophthalmitis not responding to intravitreal injections

Recent studies recommend primary vitrectomy, intravitreal antibiotics and steroids as a gold standard of management of Endophthalmitis.

**Advantages**
1. Early vitrectomy decrease bacterial load,
2. Remove most of the inflammatory destructing cells and mediators and bacterial toxins
3. Remove the scaffold (vitreous) for bacterial proliferation
4. Clearing ocular media

**Disadvantages**

- Fragile necrotic retina - chances of retinal breaks and hence retinal detachment
- Silicone oil may be injected in certain cases like endophthalmitis with associated RD, extensive areas of retinal necrosis or if an iatrogenic breaks/dialysis develops during vitrectomy. Silicone oil provides a clear media and helps to compartmentalize the vitreous (no space/scaffold for organisms to grow). It also helps to restore the ocular anatomy and functions.

**Chronic delayed onset Endophthalmitis (Figure 3)**

Chronic Endophthalmitis is very commonly misdiagnosed as uveitis or post operative inflammation. It has a high rate of recurrence, and culturing the organism (mostly P. acnes) is difficult because it is enclosed in the synechised capsular bag.

**MANAGEMENT**

**Step 1**
Intra-vitreal vancomycin (drug of choice for P. acnes) 1mg /0.1 ml

**Step 2**
If no improvement, consider PPV
Management of traumatic Endophthalmitis is different and requires a more aggressive approach. Systemic (intravenous antibiotics) should be administered. Steroids are to be given to control inflammation and early vitrectomy should be considered as the involved organisms are more destructive.

**Various measures for preventing Endophthalmitis**

- **Antiseptics:** 5% povidone – iodine for at least 3 minutes is the most important prophylaxis in many studies; decreasing conjunctival and periorbit skin flora.
- **Available data in the literature** shows no reduction of risk of endophthalmitis with preoperative cutting of eye lashes. Taping back of the lashes and exclusion from the surgical field is recommended however.
- **Any local/systemic source of infection should be ruled out.**
- **Single use instruments are always preferable especially tubings.**
- **Topical antibiotics especially 4th generation fluoroquinolones appear to be very effective in reducing conjunctival flora load. But no controlled clinical trials prove their effect in reducing incidence of Endophthalmitis.**
- Similarly, the efficacy of antibiotics in the infusates and postoperative subconjunctival antibiotics is unproved.

**Prognosis in endophthalmitis** depends on:
- **Culture results** (better prognosis in culture negative cases)
- **Timing of disease onset** (good prognosis with delayed onset)
- **Virulence of organism:** More virulent organisms such S. aureus, Streptococcus species, Bacillus species, Pseudomonas cause rapidly progressive damage and carry the worst visual outcomes.
- **Low virulent organisms** such as S. epidermidis and P. acnes are associated with indolent course and carry better visual outcomes.

**REFERENCES**


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**Financial Interest:** The authors do not have any financial interest in any procedure/product mentioned in this manuscript.
Definition – Clinical audit is a quality improvement process that seeks to improve patient care and outcomes through systematic review of care against explicit criteria and the implementation of change.

Types of Audit

The Audit can be of the Structure, process or outcome. For clinical audit we concentrate on the processes and outcomes. The process would include those involved in investigations, treatment or procedures and the outcome would deal with the response, result of intervention or the eventual change in the health status.

We can further classify the types into
1. Standard based – to compare a certain protocol against a given standard
2. Adverse/critical incident- the adverse events are screened and monitored to understand and rectify the root cause
3. Peer review- these are often multidisciplinary and help to standardize procedure
4. Patient survey- to understand their point of view

The clinical audit can help to understand the appropriateness and effectiveness of a particular treatment or the efficacy of a procedure in terms of its optimal effect, timeliness, expense and outcome.

Why should I bother doing a Clinical Audit

• Critical analysis of your own can help self improvement
• Critical look at the system that delivers care to your patient

What are the characteristics of an Audit?

1. Transparent
2. Information is used to plan improvements
3. Compare with established standards
4. Often multidisciplinary
5. Involves good communication and team work
6. Not intended for confrontations

Skills required for the audit team

1. Leadership and facilitation
2. Understanding of the process
3. Ability to collect and analyze data
4. Coordination with the management to implement change when needed

Ethics committee approval is not required for an audit; however, it is conducted within an ethical framework and abides by principles of data protection and patient confidentiality

The audit Cycle

1. Preparation and planning- includes choosing a topic, agreeing to objectives, and reviewing the evidence
2. Measuring performance – Set the standards and criteria, do a pilot if needed and collect data
3. Followed by analyzing the findings
4. Implementing change – discuss the findings with the stakeholders and make the changes in accordance to the desired change
5. Sustaining improvement – Important to re audit to see if the change is being sustained

How to choose a topic

This is the most important step as the purpose of the audit determines the eventual impact it shall have. The following points can be used to choose a topic
1. High volume – what type of patients do you see in big numbers as a change will have a big impact. E.g. improve the visual acuity outcomes after cataract surgery by analyzing the preoperative morbidity.
2. High cost – this too will have a cost effective impact
3. High risk – this is important for a favorable outcome. E.g. audit of endophthalmitis cases to understand cause
4. Benefit for patient – e.g. waiting time audit to understand critical areas which are amenable to change
5. Measurable – unless you can measure it, it is hard to audit
6. Amenable to change
7. Interesting
8. Gut feel – some topics are chosen by instinct

Once a topic is thought of, one must phrase it positively such that the outcome will be thus designed. So try and begin with – to improve, to enhance, to ensure, to increase etc. For e.g. “...to improve the registration process in the hospital”

How to write a topic

• Topic: Corneal Ulcers
  • Purpose: to improve the care received by patient of
**Setting Standards**

Once the topic and objectives are decided upon we need standards against which we shall compare.

“A Standard is an explicit statement describing the quality of care to be achieved, which is definable and measurable.”

The standard has 2 components - A criteria which defines what should happen and a target which expresses the desired performance level expressed as a percentage. It is important to set the standards with these components. This makes the standard SMART which means specific, measurable, agreed, relevant and theoretically sound. Any exceptions or valid reasons for non compliance should also be stated.

To set standards one can use the national guidance standards, professional organizational guidelines, research evidence etc. It can also be agreed upon based on standardized protocols. The strongest standards are based on systemic reviews of randomized control trials and weakest on personal experience and opinion.

So to the above topic of corneal ulcers we can add the standard

**Standards**

- 90% of the corneal ulcer patients will be seen within 30 minutes of the registration
- 100% will have scraping and syringing done
- Exceptions
  - Perforated ulcers
  - Infiltrate less than 1mm

**Measuring level of performance**

The data collection needs planning. The sample size depends on the size of the population, degree of accuracy and confidence required. The table can be used for reference.

**The sampling can be done by the following methods**

1. Simple random- collect the data and choose sample by random numbers generated by the computer. So every

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Dr. Monica Gandhi 
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Dr. Shroff’s Charity Eye Hospital, New Delhi
entry has an equal chance to participate
2. Consecutive – let’s say all patients of corneal ulcer seen in a particular month
3. Interval – e.g. patients admitted in septic ward between March and September
4. Two staged- start with a small sample and if the results not conclusive take a larger sample
5. Stratified – if the sample is divided into males and females and their ratio is 1:3 then the sample should also be chosen in that proportion.
6. Quasi random – in a population of 1000 the sample size is 278 so every 4th patient to be included. But if we start with the 1st always then 2nd and 3rd will never be included. So one can start from let’s say 5th patient.
7. Rapid cycle – small but repeated samples

Data collection
This requires a good record keeping system and should be carried out by fair and impartial methods maintain anonymity. Do not tend to collect more than what is needed to determine the objectives set. It helps to record the data of people collecting the data. Collect the information in a data sheet in a logical sequence and section headings and keep a record for future reference.

The data can be retrospective or prospective:

Data analysis
Eyeball the data to look for any gaps or errors. You could check every 10th entry to see authenticity and completeness of the data. Use statistical tests which are appropriate for analysis. For majority of audits simple descriptive statistics are sufficient.

Reporting the audit and implementing change
Once the analysis is done statistically the stakeholders are to be involved to understand the cause of gaps which are found and find interventions to bridge the gap. If the audit shows substandard care it is unethical not to act on these findings. Negotiation, leadership and motivational skills are called for at this stage of the cycle. The changes will require organizational, group and individual level involvement and at times will require interventions to identify barriers to change. The intervention plan should be chalked out with allocation of time and work responsibilities to ensure that it is implemented.

Sustaining improvement
It is fruitless exercise if the interventions are not implemented and maintained. Thus after a stipulated time period a reaudit is conducted to check.

Audit Vs Research
Research is the search for new knowledge and audit tells us if we are doing what we should be doing.
There are similarities between the two – both
1. Answer a specific question relating to quality of care
2. Retrospective or prospective
3. Involves sampling and analysis

The interface between the two
1. Clinical audit is the final stage of any audit
2. Research is the precursor of clinical audit
3. Research can identify areas for audit and audit can identify where research evidence is lacking
4. Audit assist in dissemination of evidence based practice.

Benefits of audit for patients
1. Highlights patient needs and involves them in the process
2. Improves quality of care
3. Brings timely change

Benefits of audit for health care professionals
1. Provides standard and measures quality
2. Analyses problems
3. Ensures appropriate skills and resources
4. Increases knowledge
5. Improves communication and encourages teamwork
6. Identifies training needs

Benefits to organization
1. Improves care
2. Enhances professionalism and accountability
3. Aids in continuing education
4. Aids in administration
5. Efficient use of resources

CONCLUSION
Audit is neither a threatening nor a cost cutting exercise, it is a culture development which can benefit the patients, health professionals and the organization.

An example Audit
Period of study: November -December 2014 all patients diagnosed as angle closure glaucoma (PACS, PAC, PACG)

Purpose of audit:
1) To ensure that the protocol for management of Angle closure glaucoma is followed
2) To improve the prescription and execution of YAG PI in the angle closure cases where indicated
YAG PI is indicated in angle closure cases where
1. The angle is detected as occludable for 3 or more quadrants as observed in goniscopy
2. Patient has occludable angles and is symptomatic
3. Fellow eye has acute angle closure
4. Family history of angle closure with patient has occludable angles
5. Deferring surgery for some reason in angle closure
6. One eyed patient with occludable angles
7. Patient requiring frequent dilatation of pupils and has occludable angles

Benefits of audit
1. Improves care
2. Enhances professionalism and accountability
3. Aids in continuing education
4. Aids in administration
5. Efficient use of resources

Table 4: Re Audit Process

<table>
<thead>
<tr>
<th>All standards were met</th>
<th>Repeat process to ensure it is maintained</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Data for those standards</td>
</tr>
<tr>
<td>All standards were not met</td>
<td>After action implementation: repeat entire</td>
</tr>
<tr>
<td>No</td>
<td>Review and modify standards - repeat</td>
</tr>
</tbody>
</table>

www. dos-times.org 59
Standards
1. 100% of patients to have applanation tonometry done as per protocol
2. 100% of glaucoma patients to have gonioscopy done and documented as per protocol
3. 100% of patients falling into the above indication criteria to be prescribed YAG PI (or other means to relieve pupil block-like surgery)
4. At least 80% of those with PAC, PACG advised should have YAG PI done
5. In PACS group the conversion to be based on associated risk factors.
(Note: we have excluded asymptomatic patients with PACS from analysis as most of these patients can be safely observed without intervention unless there are some absolute indications as mentioned above).
6. At least 80% done within 1 month of prescription

Data collection
All files between Nov-Dec 2104 marked as PACS, PAC, PACG in ICD coding were retrieved and evaluated

Results
- 76 eyes of 41 patients were included

- The mean age was 53 years
- The Male: female ratio was 19:22
- Applanation tonometry was done and documented in 100% files
- Gonioscopy was done and documented in 100% files
- YAG PI was advised in 68 eyes – 89%
- In 4 patients 8 eyes it was not advised as they had concomitant cataracts and they were advised cataract surgery
- Subsets: 27 were PAC and PACG of which 23 were advised YAG PI (87%)
- Of these 23 advised 8 (35%) got it done, 15 (65%) were lost to follow up
- Subsets: 48 were PACS YAG PI was advised to 45 patients -93%
- 24 did not get it done (53%) they were lost to follow up
- 22 got it done (48%)
- The time range between advised and done was 0-24 days

Reasons
1. Cost factor
2. Lack of awareness
3. Education level

Interventions planned
1. Increasing awareness: Public lectures, Education material
2. Counseling personnel
3. Free treatment for poor patients
4. Document risk factors in cases where it is mandatory
5. Telephonic recall where procedure was mandatory and patient has been lost to follow up

Next step – Re-audit
Outcome after intervention will be measured after 2 months

REFERENCES

Financial Interest: The authors do not have any financial interest in any procedure/product mentioned in this manuscript.
A thirty year old male patient presented to the cornea clinic with complaints of redness, watering and decreased vision since 2 months in left eye. The patient gave no history of trauma or previous surgery and was not a diabetic. He was on ‘cocktail therapy’ of Moxifloxacin 0.5% e/d 1 hourly, Natamycin 5% e/d 1 hourly, Acyclovir 3% e/o 5 times/day and Atropine e/d 3 times /day.

At the time of presentation patient had visual acuity of 6/9 in the right eye and finger counting close to face in the left eye. The slit lamp examination of left eye showed circumcorneal conjunctival congestion and cornea revealed large epithelial defect measuring 8×7mm with infiltrate surrounding the defect involving 9 clock hours. This was associated with around 90% thinning in central cornea. The right eye was within normal limits.

At this point therapeutic penetrating keratoplasty in this case looked inevitable. The challenge lay in controlling the infection and the key was to know the causative organism. A detailed microbiological evaluation was done, the first step being the collection of infective material by careful corneal scraping. The Gram stain revealed gram positive organism and KOH mount did not show fungal hyphae. The patient was started on fortified cefazolin (5%) and fortified amikacin (2.5%) eye drops two hourly after a loading dose with cyclopegic eye drops. The patient was also started on course of Doxycyclin 100 mg twice daily. The other antiviral and antifungal eye drops were discontinued. At this stage therapeutic keratoplasty was deferred for 24 hours to see the response of medical therapy. To our surprise the patient responded to the topical medications and stopping of unnecessary keratotoxic medications stabilised the corneal condition. On the third day a significant growth of corynebacterium diphtheria in Blood Agar and Chocolate Agar was seen with sensitivity to the prescribed medication. The patient started to show significant improvement by then. The edges of the ulcer became round, epithelial defect decreased in size and the infiltrates decreased and finally the keratitis healed with scarring in two weeks.

Thus prompt identification of the organism and starting sensitive medical therapy helped us salvaging the eye and deferring therapeutic keratoplasty in this case.

DISCUSSION

Infective Keratitis is one of the major causes of avoidable blindness. The paramount factor contributing to this blindness is in-appropriate initial therapy. Corynebacterium diphtheria is a nonmotile, non-capsulated, club-shaped, gram positive bacillus. Incidence of corynebacterium diphtheria among gram positive organisms is as low as 0.3% but is a common pathogen causing keratitis. The incidence of diphtheroids as a causative organism for bacterial keratitis has been found to be 12.5%. (reference 2,3). Corynebacterium diphtheria keratitis presents with copious discharge apart from corneal infiltration. The bacteria has the potential to invade intact epithelium also. Bacterial Keratitis patients can be managed as outpatients. The choice of specific antimicrobial agent will hit the bull’s eye. Treatment is initiated based on smears, without waiting for the results of culture and sensitivity. Initial empirical therapy for bacterial keratitis involves frequent instillation of...
broad-spectrum antibiotic drops. Many prefer combination therapy, wherein, a cephalosporin is combined with an aminoglycoside. The cephalosporin covers the gram-positive cocci and some gram-negative rods, and the aminoglycoside, the gram-negative ones. Commonly, 5% cephazolin is combined with 1.3% tobramycin. Monotherapy, using only one fluoroquinolone, is also effective. Ciprofloxacin 0.3%, Ofloxacin 0.3%, Gatifloxacin 0.3% or Moxifloxacin 0.5% 28 may be used. However, monotherapy is usually reserved for keratitis which is not severe or does not involve the visual axis.

Whatever the chosen strategy, drugs are started intensively. Initially loading dose is followed by hourly administration of anti-biotics for the first 48 hours. The frequency is tapered once the infection is controlled. These patients need a close follow up with proper documentation on every visit.

In this case the identification of the causative organism and targeted therapy helped in complete resolution of Corynebacterium keratitis thus avoiding the need for therapeutic keratoplasty which has a poor outcome in inflamed infective eye and also adds to the financial burden on the patient.

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Financial Interest: The authors do not have any financial interest in any procedure/product mentioned in this manuscript.
ELECTRORETINOGRAM (ERG) TO THE RESCUE

Raman Mehta, Batriti Wallang

CASE 1

A 14 year old girl presented to the out-patient department with the chief complaints of difficulty in seeing at night time and in dim illumination noticed from early infancy. Her parents felt that the symptoms have remained more or less constant since onset. She had a history of three previous consultations elsewhere before, between the ages of 2 to 6 years, where she had been labelled as a case of retinitis pigmentosa or atypical retinitis pigmentosa based on a flat electoretinogram (ERG) and hypopigmented areas on fundus evaluation. No other significant birth, systemic or ocular history could be elicited. There was no family history of retinitis pigmentosa. Her visual acuity documentation in the previous reports was 6/18 in both eyes, for distance, at the age of 8 years. Previous visual acuity documentation at an earlier age were unreliable due to poor response. She had also had an MRI brain and CT scan brain done on two occasions previously which were normal. She had also undertaken a course of vitamin A prophylaxis during this period.

Ocular examination showed that she had a best corrected visual acuity of 6/12p for distance in both eyes by Snellen's chart, with a refraction of +0.5 D sph/-2.50 X 180 in the right eye and +0.5 D sph/-2.50 X 5 in the left eye. She had an intermittent exotropia phase 3 with a manifest right exotropia. Her extraocular movements were full and free. No nystagmus was present and colour vision was normal. Her anterior segment and the posterior segment examination were unremarkable.

Based on the above findings, which were inconclusive for retinitis pigmentosa, and the parents’ apprehension regarding the visual prognosis, we decided to go ahead with a repeat ERG to ensure no alternate cause for the patient’s night blindness. A flash ERG to our surprise showed a reduced scotopic response with a negative b wave form in combined response (Figure 2). This is typical for congenital stationary night blindness. ERGs done at an early age for CSNB may not show the typical wave forms. The parents were reassured about the non-progressive nature of the condition, as opposed to retinitis pigmentosa, and asked to follow-up with us after a year.

CASE 2

A 4 year old male child came to our hospital with the chief complaints of watering in both eyes. The patient was a known case of pulmonary hemosiderosis on treatment with hydroxychloroquine (HCQ) at a dose of 50 mg BD for last one year. He had been advised a routine ocular examination by the treating physician. There was no history of any visual complaints according to the parents.
On examination his uncorrected visual acuity was 20/50 in the right eye and 20/40 in the left eye. His best corrected visual acuity was 20/50 with +1.50 X 100 in the right eye and 20/40 with +1.50 X 80 in the left eye.

The anterior segment and the pupillary evaluation were normal and the fundus examination also revealed a normal foveal reflex (Figure 3). Colour vision examination was also normal by Ishihara chart.

A differential diagnosis of both eyes simple hyperopic astigmatism was made with the possibility of meridional amblyopia due to oblique astigmatism to explain the decreased visual acuity. Glasses were advised. However, in view of the history of hydroxychloroquine intake for the past year, a differential of drug retinotoxicity was kept in mind and the patient was advised a multi-focal ERG to illicit any macular pathology. An automated visual field examination was not possible for the patient at this age.

The Full field ERG showed reduced scotopic and photopic response (Figure 4), while the multifocal ERG revealed decreased foveal, parafoveal and perifoveal rings with no foveal peak in both eyes (Figure 5). The dose limit considered within the safety margin for toxicity for HCQs is 6.5mg/Kg which this patient...
was taking. However, considering the history of HCQ intake along with reduced central retinal function demonstrated on multifocal ERG, in the absence of other retinal pathology, a diagnosis of HCQ retinotoxicity was made. The patient was sent back to the consulting pediatrician to change the oral drug or manage the dose accordingly.

Electroretinographic testing methods are indispensable parts of the evaluation of patients with hereditary retinal diseases. Full-field ERG has an important role in the diagnosis and follow-up of patients with retinal functional abnormalities and a normal-appearing fundus. In some clinical situations, full-field ERG may also help in the differential diagnosis. Multifocal ERG is a complimentary test to full field ERG where the decreased visual acuity may not be explained in a normal appearing fundus.

Financial Interest: The authors do not have any financial interest in any procedure/product mentioned in this manuscript.
Walking into a room filled with complete and utter darkness, a person may find themselves searching for that bit of light to help them become oriented. Once that light is located, the room is filled with brightness; that person may feel a sense of relief and familiarity. Light means radiance; it can offer a person a sense of reassurance. But for those facing vision loss, that once bright shining light may become dim as the realization of their declining eyesight becomes more evident. Metaphorically and literally speaking, their world is turning into darkness before their eyes.

Shock
Total Loss
Fear
In Security
Sadness
Anger
Doubt

It is trauma Counseling’s aim, to help those who have recently been impacted by vision loss, find their light again. The mission of trauma Counseling is to provide direct counseling to blind/visually impaired individuals and/or their families by assisting in coping with the healing and adjustment process of vision loss.

Here we help these newly blinded patients to first accept the harsh fact that they are now blind and that no amount of treatment or faith healing can get their lost sight back!

Once the above is achieved successfully, the newly blinded patients and their families are prepared to accept, and directed towards suitable rehabilitation services, and via this put back into being productive and useful citizens.

As an Ophthalmologist, you would often find yourself faced by patients, with irreversible disability due to sight loss. We are certain that even though you were not able to cure their ailment, you would wish to help them get on in life and make the most of whatever they have and become productive citizens! This, would as you are aware, would entail expert and timely psychological counseling, via which these patients could be motivated to go into emotional and physical rehabilitation, so they don’t lose precious time in going from doctor to doctor or faith healer to faith healer, ultimately being victimized and suffer further loss of money and resources as well! And in the bargain, remain burdens to themselves, their families and the society!

To help your newly blinded patients get to once again be able to properly manage their lives, we need to first of all, assist them to accept their disability, facilitate them to get access to relevant support, information and advice as to all the available avenues and resources that can actually quickly and effectively put their traumatized and disheveled life back into order! We need to, once again get them to believe in themselves, move away from despair and depression and understand that just losing sight does not necessarily mean end of the world; that there is still so much they can still do for themselves and for others! And most of all, they can once again get on and live with self-confidence, self-respect and dignity!

This, as you are aware, is a considerably time taking task, and, also considering the fact that your time is precious, such individual attention is feasible only at the cost of turning away other patients, which further means depriving the other needy patients of your expertise.

However, today there are experts and professionals, to take over this task, to guide and support the newly blinded patients and their families through this entire process. In case you come across anyone with a visual impairment, all you need to do now is, to refer him/her to Silver Linings!

Silver Linings offers comprehensive trauma counseling for visually disabled persons and their care-givers. This service is personally provided by me, Preeti Monga, a highly experienced and outstandingly effective trauma counselor. I have been visually impaired since childhood, and have firsthand experience of thriving in the mainstream, plus, I have most effectively counseled a multitude of disabled persons and their families, teachers and employers for over 25 years now.

We offer trauma counseling to the newly disabled people and their families, and thereafter, guide and refer them to
suitable organizations and institutions for proper rehabilitation and training services. And a little support from your side would actually be able to positively transform the life of your newly blinded patient; who would in turn thank you for your valuable and timely guidance and referral!

Services offered:

- Coming to terms with and accepting the affliction.
- Infusing hope for the short term and long term future.
- Educational and career counseling, as per requirement.
- Instilling the importance and will to participate in day-to-day activities within the home and society.
- Building enthusiasm and helping develop goals and vision.
- Personality development and relevant behavioral and communication skills.
- Appreciating the power of the other remaining senses.
- Eliminating the embarrassment and shame of having a disabled member in the family.
- Understanding the importance of the family’s role in the entire rehabilitation process.
- Helping in the identification of a suitable rehabilitation center.

Both for the patient and their families, as well as the society at large, we tap into existing opportunities and create new ones, to demonstrate that ‘disability’ need not become a ‘handicap.’ Instead, it must be managed and handled correctly, by seeking expert guidance and support in a timely manner. Persons with disabilities have equal rights and desire to enjoy the varied opportunities and pleasures of this universe, as much as the able-bodied do.

We look forward to references of your visually challenged patients, so we could help them feel better equipped and more confident in becoming equal contributors and participants in society, instead of the unfortunate burden they usually end up becoming.

All you need to do is to share my mobile number and my e-mail ID, with your newly blinded patients, and urge them to connect with me urgently! My details are as below:

**Name:** Preeti Monga  
**Mobile number:** 91 9871701646  
**E-mail ID:** Preeti.monga@silver-linings.org / Preeti.monga@gmail.com
ATTENTION – DELHI VOTING MEMBERS
MANDATORY ADDRESS UPDATE

ALL DOS MEMBERS ARE REQUESTED TO KINDLY UPDATE THEIR ADDRESS
Log on to www.dosonline.org > member services > UPDATE PROFILE
Display of updated voter list on DOS website will be available from OCTOBER 15, 2016.

Request for update of member profiles will be entertained till January 15, 2017.
(see page 76 for more details).

ATTENTION – ALL DOS MEMBERS
DOS TRAVEL FELLOWSHIP DETAILS

Details of DOS International Travel Fellowship for partial financial assistance are available online (see page 75 of this issue for more details)
Log on to www.dosonline.org > member services > Fellowships

DOS LIBRARY ONLINE

E – Books & E – Journals accessible ONLINE
Log on to www.dosonline.org > DOS LIBRARY

Delhi Journal of Ophthalmology

All members are requested to contribute quality manuscripts for DJO
Log on to www.djo.org.in to view DJO ONLINE

DOS TIMES

CONTRIBUTIONS ARE INVITED FROM ALL MEMBERS FOR DOS TIMES – THE OFFICIAL BULLETIN MAGAZINE OF DOS. (please email your contributions to dostimes10@gmail.com / mvanathi.rpc@gmail.com)
Log on to www.dos-times.org
DOS Travel Fellowship for Partial Financial Assistance to Attend Conferences

Applications are invited for DOS Fellowship for partial financial assistance to attend conference(s).

Conferences

International: Four fellowships per year (Two fellowships can be awarded at a time if committee feels that papers are very good)
- Maximum of Rs. 50,000/- per fellowship will be sanctioned

National fellowship:
- The winner of the DOS best paper (A.C. Aggarwal Trophy) will be awarded complimentary registration for the DOS Winter Conference and DOS Annual Conference of the subsequent year.

Eligibility
- DOS Life Members (Delhi Members only)
- 75 or More DCRS Points
- Accepted paper for oral presentation, poster, video or instruction course.

Time since last DOS Fellowship
Preference will be given to member who has not attended conference in last three years. However if no applicant is found suitable the fellowship money will be passed on to next year. Members who has availed DOS fellowship once will not be eligible for next fellowship for a minimum period of three years.

Authorship
The fellowship will be given only to presenting author. Presenting author has to obtain certificate from all other co-authors that they are not attending the said conference or not applying for grant for the same conference. (Preference will be given to author where other authors are not attending the same conference). If there is repeatability of same author group in that case preference will be given to new author or new group of authors. Preference will also be given to presenter who is attending the conference for the first time.

Quality of Paper
The applicant has to submit abstract along with full text to the DOS Fellowship Committee. The Committee will review the paper for its scientific and academic standard. The paper should be certified by the head of the department / institution that the work has been carried out in the institution. In case of individual practitioner he or she should mention the place of study and give undertaking that work is genuine. The fellowship committee while scrutinizing the paper may seek further clarification from the applicant before satisfying itself about the quality and authenticity of the paper. Only Single best paper has to be submitted by the applicant for review (6 copies). Quality of the paper will carry 50% weightage while deciding the final points.

Poster and Video
The applicant will need to submit poster and video for review.

Credit to DOS
The presenter will acknowledge DOS partial financial assistance in the abstract book / proceedings.

The author will present his or her paper in the immediate next DOS conference and it will be published in DJO/DOS Times.

Points Awarded

1) Age of the Applicant

   a) < 35 years 10
   b) 36 to 45 years 07
   c) 45 years plus 05

2) Type of Presentation

   a) Instructor/ Co-instructor of Course 12
   b) Free Paper (Oral) / Video 07
   c) Poster 05

3) Institutional Affiliation

   a) Academic Institution 15
   b) Private Practitioner 20

4) The points awarded for DCRS rating in the immediate past year:

   a) > 150 10
   b) 75 – 150 5
   c) < 75 Not Eligible

Documents
- Proof for age. Date of Birth Certificate.
- Original / attested copy of letter of acceptance of paper for oral presentation / video / poster or instruction course.
- Details of announcement of the conference.
- Details of both International & National Conferences attended in previous three years.
- Copy of letter from other national or international agency / agencies committing to bear partial cost of conference if any.
- Original air travel boarding passes and photocopy of the attendance certificate of the conference.
- Fellowship Money will be reimbursed only after submission of all the required documents and verified by the committee.
- Undertaking from the applicant stating that above given information’s are true.
- If found guilty the candidate is liable to be barred for future fellowships.

Application should reach DOS Secretary’s office and should be addressed to The President, DOS before March 15, June 15, September 15 and December 15. The committee will meet four times in a year in the month of March, June, September & December within 2 weeks of last date of receipt of applications. The committee will reply within four week of last date of submission in yes/no to the applicant. No fellowship will be given retrospectively, that means prior sanction of executive will be necessary.

Delhi Ophthalmological Society
Room No. 479, 4th Floor,
Dr. R.P. Centre for Ophthalmic Sciences
AIIMS, Ansari Nagar, New Delhi - 110029
FOR KIND ATTENTION OF DOS VOTING MEMBERS

The recommendations of the Electoral Review Subcommittee as approved by Executive of DOS on 5th August 2015:

I. DISPLAY OF THE LIST OF VOTING MEMBERS ON THE WEBSITE

It was suggested that the name and address of all voting members be displayed as the VOTER’S LIST on the DOS website. The online display of the updated voter’s list on the DOS website is to be ensured by October 15 each year. This is to be performed by the treasurer with the concurrence of the DOS President & Vice President.

II. PROFILE UPDATE BY THE DOS MEMBERS

It was emphasized that all DOS Members be responsible for updating their address change and voting status. Regular email communications may be sent out by the secretary / treasurer requesting for the same. Profile update is possible only on written request / email request from the member to the DOS General Secretary. The same may be acknowledged and profile update status be confirmed to the requesting DOS member within a stipulated time frame. It was suggested that provision for entry of alternate email ids be given in the member profile page so that communications for address change can be sent to more than one email id. Request for update of member profiles may be entertained until 15th January of the following year. Members providing false information/declaration of their address status will be subject to severe punitive action as per recommendations of disciplinary committee assigned to formulate these.

III. CONCERNS REGARDING EXISTING VOTER LIST

a) The committee addressed the apprehension that the current voters list contains names of DOS members who are no longer voting members and how the same be rectified. The committee deliberated upon the best way to ensure that all such members are made to update their address and voting status. It was reiterated that in the current scenario, the onus of address change should be placed on the members and they are required to provide an honest declaration of their current working & residential address and thereby their voter status.

b) It was also stated that senior DOS Members, who retire from practice and are still residents of Delhi, be considered as voting members. In other words working address is not essential if residential address is Delhi.

c) It was also opined that a complaint regarding status of voting member may be sent to the Secretary by any Delhi member (in case of members whose voting status is doubted or if a name is inadvertently omitted). Such complaints to the DOS Secretary should not exceed 25 per DOS member complainant & November 30th will be the last date for filing such complaints.

d) All facts pertaining to such complaints are to be verified by a committee consisting of the President, Vice president and the Treasurer. This could include seeking a clarification from the members and any other step considered appropriate. The committee will implement its decision after due notice to the member.

IV. ELECTION CAMPAIGN

It was agreed upon that non-ophthalmologists will not be allowed to campaign on behalf of the candidates at the conference/ election venue.

V. ELECTORAL PROCESS

a) The CV of all electoral candidates may be displayed on the DOS website following last date of withdrawal.

b) Last date for withdrawal of nomination to be 6 weeks prior to the date of election.

c) It was agreed upon that no DOS office staff be enrolled to participate as officiating staff of the electoral process.

d) The election area be well secured so that no unauthorized person can gain access.

e) Only members on the voter list and producing valid id document will be permitted to vote.

f) No validation by third parties will be permitted / recognized as identification during the voting.

g) A change of address within Delhi will not constitute a reason for disqualification from voting, as long as name is on voter list and there is a valid id.

h) In the event of any misconduct by members / contestants / voters during the electoral process, complaint may be made to the Election Commission / Appellate Committee which will investigate the complaint & if the misconduct is established, graded punitive action will be taken as per recommendations of the Disciplinary Committee assigned to formulate these.

VI. CUSTODY OF ELECTION RELATED DOCUMENTS IN THE EVENT OF DISPUTE

Custody of election related documents will be with the Election Commissioner. These will be handed over to the DOS office within 6 weeks of the date of the election. In the event of any dispute, the custody of election related documents will remain with the election commissioner till resolution of the dispute. Copies will be furnished as required to appropriate authorities.
Q. Which of the following is true regarding Merkel cell carcinoma of lid?
   a. It is a slowly growing benign tumour.
   b. It typically affects young females.
   c. Treatment is mostly by radiotherapy.
   d. Systemic workup to rule out metastasis is required.

Q2. Short wave automated perimetry uses
   a. Blue stimulus on a white background
   b. Blue stimulus on a yellow background
   c. Yellow stimulus on a white background
   d. Yellow stimulus on a blue background

Q3. Which of the following is not a common cause of acute retinal necrosis?
   a. Varicella zoster virus
   b. Herpes simplex virus 1
   c. Herpes simplex virus 2
   d. Cytomegalovirus

Q4. Which condition shows an ‘ILM drape’ sign on OCT?
   a. Pseudo macular hole
   b. Lamellar macular hole
   c. Perifoveal telangiectasia
   d. Solar retinopathy

Q5. What percentage of symptomatic posterior vitreous detachment with vitreous haemorrhage have retinal breaks?
   a. 5%
   b. 15%
   c. 30%
   d. 80%

Q6. Which of the following occurs uncommonly in giant cell arteritis?
   a. AION
   b. III CN palsy
   c. CRAO
   d. OIS

Q7. Which of the following is an ideal environmental OR condition?
   a. Temperature 21 degree Celsius, relative humidity 20%
   b. Temperature 37 degree Celsius, relative humidity 20%
   c. Temperature 21 degree Celsius, relative humidity 40%
   d. Temperature 37 degree Celsius, relative humidity 40%

Q8. Christmas tree like deposits are seen on the anterior capsule of lens in
   a. Glaukomflecken
   b. Siderosis
   c. Wilson disease
   d. Pseudoexfoliation

Q9. What sign is being seen in the following clinical photograph and what seems to be the most likely etiology?

Q10. What imaging modality is being shown here and what seems to be the likely diagnosis?
   a. Fluorescein angiography, age related macular degeneration
   b. Fluorescein angiography, pattern RPE dystrophy
   c. Autofluorescence, age related macular degeneration
   d. Autofluorescence, pattern RPE dystrophy

Compiled by:
Dr. Rajendra Prasad Centre for Ophthalmic Sciences,
All India Institute of Medical Sciences, New Delhi, India

Dr. Devesh Kumawat MD
Senior Resident, Vitreo Retina Services
Q11. Trans illumination iris defects shown in the clinical photograph are seen in which condition?
   a. pseudoexfoliation  
   b. herpes zoster iritis  
   c. pigment dispersion  
   d. senile iris atrophy

Q12. Which of the following is not a property of Rho kinase inhibitor in the treatment of glaucoma?
   a. Contraction of smooth muscle tissue in the trabecular meshwork  
   b. Neuroprotection and ganglion cell survival  
   c. Improves optic nerve perfusion  
   d. Antifibrotic action

Q13. Nasolacrimal canal is made up of?
   1. maxillary bone  
   2. lacrimal bone  
   3. ethmoid bone  
   4. inferior turbinates  
   5. middle turbinates
   (a) 1, 2, 5  
   (b) 1, 3, 4  
   (c) 1, 2, 4  
   (d) 2, 3, 4

Q14. Which disease does not have the following optic disc abnormality?
   a. Trisomy 13  
   b. Trisomy 18  
   c. Turner syndrome  
   d. Trisomy 22

Q15. Which of the following is true association?
   a. Hypothyroidism, Christmas tree cataract  
   b. Amiodarone, anterior capsular cataract  
   c. Wilson disease, snowflake cataract  
   d. Alport syndrome, posterior polar cataract

DOS TIMES Quiz Rules
1. DOS TIMES QUIZ will now feature as 5 Episodes (Episode 1: July-August, Episode 2: September – October, Episode 3: November – December, Episode 4: January – February, Episode 5: March – April). Entries will have to be emailed before the last date mentioned in the contest questions form. Late entries will not be entertained.

2. Please email [as scanned PDF ONLY] completed responses for the quiz along with details of the contestant filled in and signed to dostimes10@gmail.com (with cc to dosrecords@gmail.com) or mail to DOS Times Quiz, Dr. M. Vanathi, Room No. 479, 4th Floor, Rajendra Prasad Centre for Ophthalmic Sciences, All India Institute of Medical Sciences, New Delhi.

3. Nonmembers may also send in their entries but will be required to send along with their completed entries, the completed membership application (with the required documents) to enroll as member. Failing this their entries into the contest will not be considered.

4. Contestants are requested to attempt all the 5 episodes of the QUIZ contest and send in their applications within the date specified. No entries will be entertained after the last date. The scores of each contestant for all 5 episodes together will be compiled at the end of episode 5 and the winner will be announced at the DOS Annual Conference in April 2017. In the event of more than one winning contestants, a draw of lots will decide the winner. Winner of each episode will also be published in the next episode along with the previous episode answers.

5. Please write to dostimes10@gmail.com/dosrecords@gmail.com for further clarifications if any.


Prof. Tewari has written textbooks on (i) Manual of Vitre-Retinal Surgery, (ii) Indirect Ophthalmoscopy, (iii) Lasers in Ophthalmology, (iv) Manual of Fluorescein Angiography and contributed Chapters in many books. He has organized and conducted many Workshops, Symposia, Updates and Instruction courses in various specialties of Ophthalmology especially in Retina in all parts of the country and a Community “Reach-in programme” was launched at Dr. R.P. Centre for patients from rural and urban slum areas for Cataract Surgery at Dr. Rajendra Prasad Centre. He has established the Retina Lab at Dr. Rajendra Prasad Centre for Ophthalmic Sciences AIIMS, New Delhi.

He has been awarded the Achievement Award By American Academy Of Ophthalmology 2007, Lifetime Achievement Award By All India Ophthalmological Society 2008, Lifetime Achievement Award By South Asian Academy Of Ophthalmology 2008, Lifetime Achievement Award By Vidharba Ophthalmic Society 2009.

He has been an active member of the AIOS and served as Secretary General Vice President and President of All India Ophthalmological Society.

Compiled by Dr. Avnindra Gupta
ACROSS
2. Immunohistochemical stain for malignant melanoma(5)
4. Syndrome with branched retinal artery occlusion, encephalopathy and hearing loss(5)
7. Sign of lid retraction in dorsal midbrain syndrome(7)
9. Drug approved for symptomatic vitreomacular adhesion(11)
10. Virus commonly associated with frosted branch angiitis(15)
11. Every 10 degree off-axis rotation of a toric lens reduces correction by approximately one ... (5)
12. Nystagmus after superficial corneal lesion(5)
13. Syndrome with anterior lenticonus(6)
14. Syndrome with agenesis of corpus callosum, chorioretinal lacunae and infantile spasms(7)

DOWN
1. Nomogram designed for post penetrating keratoplasty astigmatism(10)
2. Microstent “intracanalicular scaffold” for the treatment of primary open angle glaucoma(6)
3. Malignant round cell tumour with pseudorosettes positive for neuron-specific enolase(13)
5. Square shaped polypropylene implant with four circular loops for intraoperative pupillary dilation(8)
6. Frontoethmoidal incision for lacrimal sac tumour(5)
8. Corneal stromal dystrophy stained by Congo red(7)
CLINICAL SIGNS AND PHENOMENON IN OPHTHALMOLOGY

ASTRONOMICAL NOMENCLATURE IN OPHTHALMOLOGY

1. Sunset sign - Inferior subluxation of lens - Sinking look of eyes in infantile hydrocephalus due to upgaze paresis
2. Satellite lesions - Dry looking corneal ulcer with satellite lesions in surrounding cornea in fungal keratitis. Newly active necrotising retinitis adjacent to old scars in toxoplasmosis.
3. Asteroid hyalosis - Round yellow white calcium globules in vitreous
4. Sunburst lesion - Pigmented black patch in retina as seen in resolved haemorrhage
5. Macular star - Star shaped exudation around macula in hypertensive retinopathy, neuroretinitis, diabetes etc
6. Pie in the sky - Superior quadrantanopsia in temporal lobe lesion
7. Macular hole - Defect of foveal retina involving its full thickness

AREAS

1. Bjerrum's area - 10° to 20° area of visual field vulnerable for glaucomatous damage
2. Broadmann area - Brain area no. 17, 18, 19 dealing with visual processing signals
3. Panum's area - Area of binocular vision without diplopia along the horopter
4. Traquair island - Island of normal vision with varying visual sensations
5. Geographical ulcer - Large viral corneal ulcer
6. Geographical atrophy - Late stage of age related macular degeneration

HOUSEHOLD ITEMS

1. Bread crumb appearance - Complicated posterior subcapsular cataract
2. Cotton wool exudates - Fluffy white patches caused by damage to nerve fibre in infarction of retina (Diabetes, HT, AIDS) due to accumulation of axoplasmic material within theNFL.
3. Cotton cheese appearance - Regression of retinoblastoma, CMV retinitis
4. Cellophane maculopathy - Epiretinal membrane
5. Copper wire - Arteriosclerosis of retinal arterioles seen in Grade III hypertensive retinopathy
6. Candle wax drippings - Exudation along retinal vessels in sarcoidosis
7. Fish Flesh - Regression of retinoblastoma in large size
8. Snowball opacities - Retinal granuloma in sarcoidosis and pars planitis
9. Silver wire - Retinal arteries in arteriosclerosis seen in Grade IV hypertensive retinopathy
10. Salt and pepper retinopathy - In congenital syphilis, rubella

NODULES

1. Bussaca’s nodule - Inflammatory nodules in granulomatous uveitis over anterior surface of iris
2. Dalen Fuch's - Granulomas between bruchs membrane and RPE (phagocytosed pigment) in sympathetic ophthalmitisis
3. Koepp’s nodule - Inflammatory nodules in granulomatous uveitis over inner margin of iris.
4. Horner Tranta’s nodule - Discrete whitish raised dots in spring catarrh at limbus
5. Lisch nodule - Pigmented hamartomatous of dendritic melanocytes over the iris in neurofibromatosis

SPOTS & DOTS

1. Cherry red spot - Red colour of fovea contrast to the milky retinal odema seen in CRAO
2. Foster Fuchs spot - Myopic retinopathy (resolved haemorrhage & pigment)
3. Roth's spot - Retinal haemorrhage with clear centre composed of coagulated fibrin including, inflammatory infiltrates, infectious organisms or neoplastic cells in SABE, anemia, leukemia
4. Elschnig spot - Yellow isolated area in retinal choriocapillar occlusion (choroidal infarcts)
5. Bitot's spot - Keratinised superficial conjunctival spots in vitamin A deficiency (late stage)
6. Brushfield spot - White or greyish brown spots on periphery of iris in Down syndrome
7. Fischer-Khunt spot - Senile scleral paque, area ofhyalinised sclera anterior horizontal rectus muscle insertion, seen in old age
8. Gunn’s spot - Light reflections from internal limiting membrane around disc and macula
9. Kaye's spot - White punctate epithelial opacities anterior to suture line of corneal graft
10. Mitendorf spot - Anterior remnant of hyaloid artery at posterior surface of lens
11. Map dot fingerprint dystrophy - Corneal epithelial basement membrane dystrophy (multilamellar basement membrane)

PHENOMENON

1. A&V phenomenon - Deviation of eyeball on upgaze and downgaze
2. Bells phenomenon - Upward rolling of eyeball on lid closure
3. Entoptic phenomenon - Visualisation of one's own ocular structure
4. Fish egg phenomenon - Silicon oil dispersion in replaced vitreous
5. Haidinger phenomenon - Seeing radial pattern of macula on entoptic visualisation.
6. Jaw winking phenomenon - Lid retraction on movement of jaw (aberrant regeneration)
7. Loch ness phenomenon - Loop of vessel on gonioscopy of infant
8. Pulfrich’s phenomenon - Perception defect of movement in two eyes due to differential signal timings in optic neuritis.
9. Pseudografe phenomenon - Ptosis improves on adduction in 3rd nerve palsy (aberrant regeneration)
10. Riddoch’s - Perception of movement not the spot (cortical lesion)
11. Uthoff’s phenomenon - Decreased visual acuity on exertion (heat) in optic neuritis (multiple sclerosis)

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Financial Interest: The authors do not have any financial interest in any procedure/product mentioned in this manuscript.

Obituary

Dr. (Mrs.) Radha Natarajan was born on 22.8.1933. She spent her early childhood in Ceylon and in a small town in Kerala called North Parur. She pursued her MBBS from Lady Hardinge Medical college Delhi and went on to do her DO from Amritsar. She did her Postgraduation from AIIMS in ophthalmology. Dr. Radha Natarajan was married to Late Dr. Ganesh Natarajan a well known physician of Delhi. She worked for several years as the associate professor of Ophthalmology in Lady Hardinge Medical College and later joined the Maulana Azad Medical College Delhi and retired as the Professor of Ophthalmology from the Guru Nanak Eye Centre. She was extremely popular among her students and was well respected by all. She passed away on 17.05.16 after a brief illness.
Greetings from the Delhi Ophthalmological Society!

On behalf of the DOS Executive, it gives us great pleasure to invite you and your family to participate in the forthcoming Joint iDOS-COSL Meeting of 2016.

The 3rd edition of the International DOS Meeting (iDOS) is scheduled from December 22-24, 2016, in conjunction with the College of Ophthalmologists of Sri Lanka (COSL) at the capital city Colombo in Sri Lanka.

The Conference includes a half-day DOS scientific Session on December 22, 2016 (2.30pm – 5.30pm) and a full-day Joint iDOS-COSL session on December 23, 2016 (9:00am – 5:00pm). A sparkling Christmas Eve Dinner with music and drinks on the night of December 24, 2016 has been planned for all the Delegates and their families. We also have a stimulating entertainment and sight-seeing program lined up.

Perched on the tropical island setting of Colombo with the scenic backdrop of the Indian Ocean, and being hosted at the 5-star Taj Samudra; this combination of exciting scientific sessions with the invigorating fun and frolic of CHRISTMAS in COLOMBO offers an exceptional and unique blend of Academics, Shopping, Travel & Leisure in the pleasing company of colleagues, friends and kinfolk.

We are confident that you will mark your calendar and hope that you will join us for this exceptional and one-of-a-kind Meeting. We invite you to reserve your places and register soon to enjoy the special discounts and benefits which the DOS is offering to all its members and their families.

The Tour Itinerary and Registration can be accessed online at www.iDOS.co.in. Please register before July 31, 2016 to avail the early bird special discounts. Limited seats are on offer.

Looking forward to welcome you all at the TAJ SAMUDRA, Colombo for a distinctive and exclusive joint iDOS-COSL Meeting and a joyful X-MAS in COLOMBO.

With Best Wishes,

Dr Rishi Mohan
President, DOS

Dr M. Vanathi
General Secretary, DOS

Contact Us:

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For More Details and to register online; please visit www.iDOS.co.in