PREFERRED PRACTICES
IN PEDIATRIC OPHTHALMOLOGY
FOR INDIA
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This preferred practices in pediatric ophthalmology is intended to serve as a guide to the clinician seeing child patients with eye problems. The manual tries to be comprehensive and not exhaustive.

Clinicians with predominantly or large pediatric ophthalmic practice are advised to read specialized texts for in depth and more up to date management of their patients.

It gives details of examination techniques in children and selectively elaborates on treatment. This handbook also includes sections describing strabismus in adults as most strabismus regardless of age are managed by pediatric ophthalmologists.

**GUIDELINE OBJECTIVES**

This is a clinical guideline for the general ophthalmologists and also practicing pediatric ophthalmologists for their basic and routine Outpatient. In depth study of the listed topics is essential for full time pediatric ophthalmologists and this is not a substitute for that.

To develop an appropriate timetable for eye and vision examinations for pediatric patients To select appropriate examination procedures for all pediatric patients To minimize or avoid the adverse effects of eye and vision problems in children through early identification, education, treatment, and prevention.
Foreword

India is the second most populous country in the world and home to over 20% of the world's blind population. Unfortunately, India is also home to the largest number of blind children in any one country.

To address this, Orbis launched the India Childhood Blindness Initiative (ICBI) and pioneered the introduction of comprehensive pediatric ophthalmology services in several states.

In our journey towards eliminating needless blindness, Orbis has worked with numerous partners including the Centers of Excellence in eye care - Aravind Eye Care System, L V Prasad Eye Institute, and Sankara Nethralaya. We established Pediatric Ophthalmology Learning and Training Centers (POLTCs) with a structured curriculum to train cadres of professionals to specifically address the eye care needs of children. These initiatives among others contributed to the development of pediatric ophthalmology as a distinct sub-specialty in the Indian ophthalmology landscape. Also, under the aegis of ICBI, Orbis has supported the development of 31 Children's Eye Centers (CEC) across 17 states of the country which remains the world's largest network of Children's Eye Centers in any one country; and the network continues to grow.

The logical next step was to consolidate the knowledge and practices of our partners. Discussions with our partners and practicing pediatric ophthalmologists reinforced the need for a Pediatric Ophthalmology Preferred Practices specific to the Indian context. We consulted our POLTCs and requested Sankara Nethralaya, Chennai to lead the development of this India-specific Preferred Practices in Pediatric Ophthalmology Feedback from POLTC Faculty and Orbis Volunteer Faculty in India was received and incorporated giving us this document which we are happy to share with you.

I thank Dr. T S Surendran and the team at Sankara Nethralaya for taking up this task and sincerely appreciate their outstanding efforts. I would also like to thank Dr. Vijayalakshmi, Dr. Ramesha Kekunnaya, Dr. Mihir Kothari, Dr. Pariskhit Gogate, and Dr. Suma Ganesh for their valuable suggestions and comments which greatly helped in making this Preferred Practices in Pediatric Ophthalmology what it is.

We hope pediatric ophthalmologists across the country will find this a useful resource in our constant endeavour to provide quality eye care to every child in need.

Best wishes,
Dr. Rahul Ali
Country Director – India
Orbis International
Foreword

I congratulate Orbis for bringing out this book and all others who contributed to it.

Pediatric ophthalmology has evolved in India for almost three decades and I have an umbilical cord attachment to the subject which started with just around a dozen ophthalmologists and has spread to over a hundred ophthalmologists at present in our country. Seeds were sown both in government and non-governmental organizations to spread the message.

A lot of interest has been shown by the young post graduates with Pediatric ophthalmology as their specialization. The speciality gets support from optometrists, anaesthetists, nursing and para medical staff. It is heartening to see many centers taking up this speciality. After all, taking care of children’s eyes is a big challenge.

Pediatric ophthalmology has a wide spectrum starting from refractive errors, congenital cataract, congenital glaucoma, ptosis and other oculoplasty disorders to retinopathy of prematurity, retinoblastoma and more.

Once again, I thank Orbis and all other contributors for bringing out this book.

Wishing the book and its readers the very best.

Dr. T S Surendran
Vice Chairman and Director of Pediatric Ophthalmology Department
Sankara Nethralaya
“The Preferred Practices in Pediatric Ophthalmology formulated by Orbis in pediatric ophthalmology comes from the collective wisdom of its 30+ partner organizations, some of the most active/proactive and best pediatric eye care centers in the world. The Preferred Practices in Pediatric Ophthalmology shall go a long way in raising the standard of children's vision care delivered in the Indian sub-continent and beyond. But it will be a true success when the Preferred Practices in Pediatric Ophthalmology is widely circulated and used, by all eye care practitioners (ophthalmologists, optometrists and orthoptists) in India and the neighbouring countries”.

-Dr. Parikshit Gogate, Pediatric Ophthalmologist, Dr. Gogate’s Eye Clinic

“The Preferred Practices in Pediatric Ophthalmology for India compiled by the pediatric ophthalmology team at Sankara Nethralaya is an excellent resource for all the pediatric ophthalmologists and general ophthalmologists practicing pediatric ophthalmology across India. The academic content is excellent and will surely benefit all”.

-Dr. Suma Ganesh, Head of Department, Pediatric Ophthalmology and Strabismus, Head of Medical Education Department, Dr. Shroff’s Charity Eye Hospital

“Pediatric ophthalmology in countries like India is rapidly gaining due attention with eye care units extending their services and addressing the specific child eye care needs. This module, on preferred practices has been designed to suit the need of pediatric ophthalmology personnel at various levels. The Preferred Practices in Pediatric Ophthalmology’s relevance stands in its modern day practice information such as the recommendations on prescribing low vision devices and the inclusion of separate guidelines to rehabilitate visually impaired infants and children with and without other developmental disorders”.

I congratulate all the authors who have put in their time and energy; and greatly appreciate the tremendous efforts of the Orbis team to bring out this publication.

-Dr. P. Vijayalakshmi, Chief, Pediatric Ophthalmology & Strabismus Department, Aravind Eye Hospital

“This concise document on clinical pediatric ophthalmology can serve as a mini-textbook. It can be used by the residents in ophthalmology and clinicians as a preferred practices for various common pediatric eye diseases. The indexing of the topics is simple and finding the relevant text is very easy. The information is the latest and accurate. General ophthalmologists will find it useful as a ready reckoner and pediatric ophthalmologists can use it as a check list while working in the clinic”.

-Dr Mihir Kothari, Director, Jyotirmay Eye Clinic, Ocular Motility Lab and Pediatric Low Vision Center

“Preferred Practices in Pediatric Ophthalmology by Orbis is really a value addition to professionals involved in children's eye care in India and other developing countries. It fulfils a much needed guideline for eye care including strabismus and eye movement disorders in children. These are standard protocols followed or adopted by most pediatric ophthalmologists which will benefit many”.

-Ramesh Kekunnaya, MD,FRCS, Head & Consultant, Pediatric Ophthalmology, Strabismus & Neuro-Ophthalmology Jasti V Ramanamma Children’s Eye Care Center L V Prasad Eye Institute (LVPEI)
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HISTORY TAKING AND PHYSICAL EXAMINATION IN CHILDREN

PATIENT HISTORY

PRESENTING COMPLAINT

1) Blurred Vision
   • Monocular/ Binocular
   • Distance/ Near (Difficulty with viewing blackboard/ television/ holding books closer)
   • Squeezing of eyes
   • Frequent blinking
   • Day/ Night difference

2) Photophobia

3) Squint
   • Onset, duration and progression
   • Variability
   • Intermittent or constant
   • Preferred eye
   • Eye movement limitation

4) Abnormal head posture/Head oscillation
   • Face turns / Head tilt / Chin up or down
   • Intermittent / Constant

5) Wobbly/ Shaking eyes
   • Time of set and duration
   • Any precipitating event like trauma, surgery, fever

6) Asthenopia
   • Related to a particular activity
   • Related to certain time of day
   • Any associated diplopia or blurring of vision
   • Symptoms relieved when initiating activity is discontinued or when patient reads with one eye closed

7) Watering / Epiphora

8) Itching and redness of eyes

9) White Reflex

10) Drooping of the eyelid

11) Diplopia

- Monocular or binocular
- If Monocular: consider corneal or pupillary abnormality, lenticular opacification or retinal pathology
- Binocular: strongly suggests strabismic origin
- Horizontal or vertical separation of images.
- Torsional can be observed by asking patient to look at the edge of a door and observe tilt
- Diurnal variation
- Worse in which gaze
- Worse for distance or near
- Precipitating factor

PAST HISTORY

- History of patching
- History of spectacle wear
- History of trauma to the eye / head
- Past ocular or strabismus surgery or general surgery

BIRTH HISTORY

- Full term or premature
- Age of gestation
- Birth weight
- Mode of delivery (normal / caesarean / forceps)
- H/o birth asphyxia
- H/o fever with rashes in mother during pregnancy
- H/o neonatal convulsions / jaundice
- H/o CRS and NICU admission
- H/o oxygenation therapy

DEVELOPMENTAL MILESTONES

- Global motor and speech development
- Any regression of milestones
- Hyperactive behaviour (autism)
- Learning disability
- Related investigations and rehabilitation done like CT or MRI
FAMILY HISTORY

- H/o consanguinity in parents
- Presence of hereditary forms of strabismus
- F/h of other inherited eye diseases in the family members
- Pedigree chart in selected cases

REVIEW OF SYSTEMS

- Neurologic symptoms
- Headache, seizures, ataxia, muscle weakness, fatigue, ptosis, bowel and bladder incontinence, facial asymmetry
- Cardiac
- Congenital heart disease, mitral valve prolapse
- Respiratory
- Wheezing, allergic rhinitis
- Tachypnoea
- Other systemic abnormalities and syndromes

EXAMINATION

VISUAL

1) 0-6 Months
   - Menace reflex
   - Visual dampening of induced nystagmus on rotation

2) 6 Months -4 Years
   - Fixation preference tests
   - Preferential looking visual acuity test
   - Teller acuity cards / Lea Gratings
   - Cardiff Acuity Cards

3) 4-6 Years
   - Lea Symbols chart
   - Broken Wheel acuity cards
   - HOTV test

4) 6 Years and Above
   - Snellen letter / ETDRS logMAR vision chart
   - KAY pictures

REFRACTION

- Cycloplegic retinoscopy
- Near retinoscopy/ Dynamic retinoscopy
- Static retinoscopy
- Subjective refraction

BINOCULAR VISION, ACCOMMODATION AND OCULAR MOTILITY IN CHILDREN

- Cover tests (cover uncover/ alternate prism cover test)
- Hirschberg test
- Krimsky test
- Brückner test
- Versions and ductions
- Fusion and stereopsis
- Bielschowsky three step test

If Required:

- Near point of convergence (NPC)
- Positive and negative fusional vergences (prism bar/step vergence testing)
- Accommodative amplitude and facility
OCULAR ASSESSMENT

• Evaluation of the anterior segment and adnexa
• Evaluation of the posterior segment
• Assessment of pupil lary responses
• Visual field screening (confrontation)
• Color vision testing
  - Pediatric color vision testing (matching chart by Helveston)
  - Ishihara screening plates
• Measurement of intraocular pressure (IOP)

The following section will give specific guidelines for examination of children of various age groups.

EXAMINATION OF INFANTS AND TODDLERS (BIRTH TO 3 YEARS)

GENERAL CONSIDERATIONS

Children in this age group generally perform best if the examination takes place when they are alert. Examination early in the morning or after an infant’s nap is usually most effective. Infants tend to be more cooperative and alert when feeding. Hence, it is also helpful to suggest that the parent bring a bottle for the child. Bottle feeding is strongly discouraged by the pediatrics all over the world for kids < 6 months age. Exclusive breast feeding is the norm. Hence, let the mother breast feed the baby in the feeding room and then examine the baby.

Modifications include relying more on objective examination procedures and performing tests considerably more rapidly than with older children.

1) Visual Acuity

Assessment of visual acuity for infants and toddlers may include these procedures:

• Menace reflex – in the dark, suddenly shine the bright light viz. full illumination of indirect ophthalmoscope. It is the first response that is important and only the positive test confirms development of the visual pathways.
• Visual dampening (within first 10 seconds) after rotation for 30 seconds on the parent’s shoulder or by the ophthalmologist
• Fixation - central, steady, maintained
• 10-PD test
• Fixation preference tests /Resistance to occlusion
• Preferential looking visual acuity test
• Lea Symbol chart

Forced-choice preferential looking with the Teller acuity cards or electrodiagnostic testing should be considered to obtain a more precise measure of baseline visual acuity.

2) Refraction

Traditional subjective procedures for the assessment of refractive error may be ineffective with infants or toddlers because of short attention span and poor fixation. As a result, the examiner will need to rely on objective measures of refraction. The three most commonly used procedures are:

• Cycloplegic retinoscopy
• Near retinoscopy
• Dynamic retinoscopy

It is important for the examiner performing cycloplegic retinoscopy in an infant or toddler to take several precautions:

• Select the cycloplegic agent carefully (e.g., fair-skinned children with blue eyes may exhibit an increased response to drugs and darkly pigmented children may require more frequent or stronger dosages)
• Avoid overdosage. For instance, children with down syndrome, cerebral palsy, trisomy 13 and 18, and other central nervous system disorders in whom there may be an increased reaction to cycloplegic agents, two % homatropine eyedrops may be used
• Beware of biological variations in children (e.g., low weight infants < 5kg require 50% dilution)

Cyclopentolate hydrochloride is the cycloplegic

Forced-choice preferential looking with the Teller acuity cards or electrodiagnostic testing should be considered to obtain a more precise measure of baseline visual acuity.
agent of choice but it is contraindicated in children with neurological disease or history of convulsions. One drop should be instilled twice, five minutes apart, in each eye, using strength of 0.5% for children from birth to one year and one % for older children. The regimen that works well in children with dark irides is one drop of cyclopentolate one % followed five minutes later by one drop of tropicamide one % and followed 5 minutes later by one more drop of one % cyclopentolate. Retinoscopy may be performed 45 minutes after instillation. The use of loose lenses or a lens rack is recommended for retinoscopy. Atropine refraction may be considered if we suspect:

1. Pseudomyopia or accommodative spasm
2. Accommodative esotropia with small residual squint over glasses
3. Vergence anomalies
4. Varying retinoscopy values

Near retinoscopy: without an accommodative target in dark, the illumination of the streak works as the non accommodative target is another objective method of estimating refractive error in infants and toddlers. However, it has not been found reliable for quantification of the refractive error. Near retinoscopy may have some clinical value in the following situations:

- When frequent follow-up is necessary
- When the child is extremely anxious about instillation of cycloplegic agents
- When the child has had or is at risk of an adverse reaction to cyclopentolate or tropicamide

The average refractive error in children from birth to one year of age is about two diopters (D) of hyperopia (standard deviation 2 D). Astigmatism up to 2 D is common in children under three years of age. Studies show that 30-50% of infants less than 12 months of age have significant astigmatism, which declines over the first few years of life, becoming stable by approximately 2½ to five years of age. Low amounts of anisometropia are common and variable in infants. The clinician may choose to monitor these levels of refractive error rather than prescribe a lens correction.

Dynamic retinoscopy is not same as near retinoscopy. While in near retinoscopy, child fixates at the light filament of the retinoscope and the accommodation is still assumed to be at rest, in dynamic retinoscopy, the child is accommodating on an appropriate object at near (33cm). It is necessary to diagnose accommodation failure especially in patients with down syndrome, cerebral vision impairment, foveal hypoplasia and internal ophthalmoplegia.

**BINOCULAR VISION AND OCULAR MOTILITY**

The following procedures are useful for assessing binocular function:

- Cover test
- Hirschberg test
- Krimsky test
- Bruckner test
- Versions

Pupillary evaluation, anterior segment and posterior segment examination to be performed as mentioned earlier.

**EXAMINATION OF 3-5 YEAR OLD CHILDREN**

**GENERAL CONSIDERATIONS**

Although the vast majority of children in this age group can communicate verbally, it is preferable in most cases for the parent/caregiver to accompany the child into the examination room. It is important to ensure that the child feels relaxed and at ease, which is often best accomplished by beginning the examination with procedures that appear less threatening.

Modifications include reliance on objective examination techniques, limited use of subjective techniques requiring verbal interaction, and performing testing considerably more rapidly than is typically used for older children.

**EXAMINATION SEQUENCE**

1) **Visual Acuity**

- Lea Symbols chart
- Broken Wheel acuity cards
• HOTV test

2) Refraction
• Static retinoscopy
• Cycloplegic retinoscopy

3) Binocular Vision, Accommodation, and Ocular Motility
• Cover test
• Positive and negative fusional vergences (prism bar/step vergence testing)
• Near point of convergence (NPC)
• Stereopsis
• Versions

Pupillary evaluation, anterior segment and posterior segment examination to be performed as mentioned earlier.

EXAMINATION OF OLDER CHILDREN (>5 YEARS OF AGE)

GENERAL CONSIDERATIONS
Some of the issues relating to younger children also apply to this population, particularly children younger than eight years old. Age-appropriate examination and management strategies should be used. Although most of the examination procedures used with this age group are identical to those recommended for adults, age-appropriate modifications of instructions and targets often may be required.

EXAMINATION SEQUENCE

1) Visual Acuity
Visual acuity may be assessed with the Snellen acuity chart (modified for children six to eight years of age). A recommended modification is the isolation of one line, or even one-half line of letters, rather than projection of a full chart.

2) Refraction
• Static (distance) retinoscopy
• Cycloplegic retinoscopy
• Subjective refraction

3) Binocular Vision, Accommodation, and Ocular Motility
• Cover test
• Near point of convergence (NPC)
• Positive and negative fusional vergences
• Accommodative amplitude
• Stereopsis
• Versions

Pupillary evaluation, anterior segment and posterior segment examination to be performed as mentioned earlier.

PATIENT EDUCATION
Educating parents or caregivers about any eye or vision disorders and vision care.

The importance of adhering to an eye and vision examination schedule should be emphasized educating parents/caregivers and children about eye safety, particularly regarding sports-related eye safety.

Importance of early, preventive eye care, including examinations at the age of six months, at age three, before entering first grade, and periodically during the school years.

RECOMMENDED EYE EXAMINATION FREQUENCY FOR THE PEDIATRIC PATIENT

AT BIRTH: RED REFLEX TEST
Detailed examination for ‘at risk infants’

BIRTH TO 24 MONTHS
Asymptomatic/risk-free: At six months of age
At risk: At six months of age or as recommended

2 TO 5 YEARS
Asymptomatic/risk-free: At three years of age
At risk: At three years of age or as recommended

6 TO 18 YEARS
Asymptomatic/risk-free: Before first standard and every two years thereafter
At risk: Annually or as recommended

Coordination, Frequency, and Extent of Care
The child’s first eye and vision examination should be scheduled at six months of age (or sooner if signs or symptoms warrant). When no
abnormalities are detected at this age, the next examination should be scheduled at age three.

The child considered at risk for the development of eye and vision problems may need additional testing or more frequent re-evaluation. Factors placing an infant, toddler, or child at significant risk for visual impairment include:

- Prematurity, low birth weight, oxygen at birth, grade III or IV intraventricular hemorrhage
- Family history of retinoblastoma, congenital cataracts, or metabolic or genetic disease
- Infection of mother during pregnancy (e.g., rubella, toxoplasmosis, venereal disease, herpes, cytomegalovirus, or human immunodeficiency virus). Difficult or assisted labour, which may be associated with fetal distress or low APGAR scores
- High refractive error
- Strabismus
- Anisometropia
- Known or suspected central nervous system dysfunction evidenced by developmental delay, cerebral palsy, dysmorphic features, seizures, or hydrocephalus

**REFRACTION**

Do subjective refraction if possible

Do cycloplegic refraction in all patients reporting to the pediatric ophthalmology clinic.

**INDICATIONS FOR CYCLOPLEGIC REFRACTION**

1) **Refractive errors**
   - To assess the refractive power of the eye (Myopia, Hyperopia and Astigmatism)
   - Poor cooperation/ fixation during refraction
   - Fluctuations in the refractive error while performing dry retinoscopy
   - Vision not correlating with the dry refraction
   - To rule out latent hyperopia
   - Refractive surgery – to assess the refractive error accurately and rule out latent component

2) **Accommodative anomalies**
   - (accommodative spasm)

3) **Amblyopia (penalization)**

4) **Strabismus (accommodative and partially accommodative esotropia)**

**Common cycloplegic agents**

<table>
<thead>
<tr>
<th>Agent</th>
<th>Strength (percentage)</th>
<th>Mydriasis</th>
<th>Cycloplegia</th>
<th>Side effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Maximum (min)</td>
<td>Recovery time</td>
<td>Maximum (min)</td>
</tr>
<tr>
<td>Phenylephrine</td>
<td>2.5</td>
<td>20</td>
<td>2-3 hours</td>
<td>None</td>
</tr>
<tr>
<td>Tropicamide</td>
<td>0.5,1</td>
<td>20-40</td>
<td>2-6 hours</td>
<td>30</td>
</tr>
<tr>
<td>Cyclopentolate</td>
<td>0.5,1,2</td>
<td>30-60</td>
<td>6-24 hours</td>
<td>25-75</td>
</tr>
<tr>
<td>Homatropine</td>
<td>2.5</td>
<td>40-90</td>
<td>1-3 days</td>
<td>30-60</td>
</tr>
<tr>
<td>Atropine</td>
<td>0.5,1</td>
<td>30-60</td>
<td>7-14 days</td>
<td>60-180</td>
</tr>
</tbody>
</table>

Dryness of mouth, Flushing, tachycardia, fever, delirium, irritability
CHOICE OF CYCLOPLEGIC AGENT

REGIMEN WHEN USING CYCLOPENTOLATE

One drop of 1% cyclopentolate is instilled at five minutes interval, followed by one drop of 0.5% tropicamide, again followed by instillation of 1% cyclopentolate once after five minutes interval.

Perform a cycloplegic refraction between 45 minutes and 75 minutes after the last drop instillation. If the cycloplegic refraction cannot be performed between 45 and 75 minutes, instill another drop of cyclopentolate one% in each eye and wait a minimum of thirty minutes more.

Regimen when not using cyclopentolate (if contraindicated especially when the child has seizures or is on antiseizure medication).

One drop of Homatropine 2% is applied followed by one drop of 0.5% tropicamide at five minutes interval. Cycloplegic refraction can be carried out appropriately in all new patients below 12 years of age, and in all children with refractive errors detected for the first time.

Atropine (1%) Ointment

- Dose: three times a day x three days
- Recommended in:
  - Accommodative esotropia
  - Accommodative spasm
  - Varying retinoscopy values

Drops for premature babies and infants <six months of age: Recommended eye drops are tropicamide 0.5% - 1% with phenylephrine 2.5%. two to three instillations of each of these drops, five minutes apart, Mydriasis in fifteen to twenty minutes and effect lasts thirty to forty five minutes.

Do wipe the drops spilled over cheeks as it can be absorbed from skin and cause increased heart rate

Avoid 10% phenylephrine in premature babies as it causes severe tachycardia, hyperthermia and dehydration

ROP drops can be prepared by mixing 3 ml of 1% tropicamide with 1 ml of 10% phenylephrine. The solution can be stored at room temperature for three days. This preparation is available commercially as well.

NOTE:
Adverse effects to be explained to parents

Children with light Colored eyes and infants may need modification of dose.

Avoid atropine in down’s syndrome, cerebral palsy, trisomy 13, 18 and other CNS disorders.

Cyclopentolate is contraindicated in children with seizures, mental retardation, cerebral palsy and other neurological abnormalities

Method

- Do retinoscopy after maximum cycloplegia is achieved
- Darken the room to avoid distraction
- Child can fixate on retinoscope light
- Use loose lenses to neutralize the reflex
- Post- mydriatic test – To be done in older children

<table>
<thead>
<tr>
<th>Infants</th>
<th>Tropicamide(1%) 1 + 1 = 20min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premature infants</td>
<td>ROP drops (3:1) (Tropicamide + Phenylephrine)</td>
</tr>
<tr>
<td>Delayed milestones, seizures and CNS disorders</td>
<td>Homatropine (0.5% -1%) + Tropicamide (1%) 1+1+1 = 30 min</td>
</tr>
<tr>
<td>Down’s syndrome</td>
<td>Cyclopentolate(0.5% - 1%) + Tropicamide(1%) 1+1+1 = 30 min</td>
</tr>
<tr>
<td>Normal children(1 – 16years)</td>
<td>Cyclopentolate (0.5% - 1%) + Tropicamide (1%) 1+1+1 = 30 min</td>
</tr>
</tbody>
</table>
BINOCULAR VISION (BV) ASSESSMENT IN CHILDREN

INDICATIONS FOR BV ASSESSMENT IN CHILDREN
- Eyestrain
- Headache associated with vision related activities
- Blurred vision not related to refractive error
- Fluctuating vision
- Difficulty reading for longer hours
- Binocular diplopia
- History of head injury
- Frequent change of glasses
- Near exophoria
- Near esophoria
- Vertical phorias
- Intermittent divergent squint
- Progressive myopia with near esophoria (myopia progression more than 0.75 D every year with near esophoria)
- Latent hyperopia
- Accommodative spasm
- Receded near point of convergence (> 6 cm using linear target or > 10 cm using penlight and red filter)
- Reduced near point of accommodation (2 diopters lesser than Hofstetter’s Minimum expected amplitude)
- Congenital nystagmus (with AHP or Null point in convergence)
- Sudden degradation of academic performance
- Functional vision loss

REFRACTION IN BINOCULAR VISION
- Estimates of refraction using open field autorefractor
- Borish delayed refraction
- Binocular balancing
- Refractive adaptation

TESTS PERFORMED SPECIFIC TO CONDITIONS

AMBYLOPIA
- Visual acuity with crowded and isolated letter
- Accommodative responses (static using Monocular Estimate Method Retinoscopy and dynamic responses using open field autorefractor)
- Binocularity – fusion and stereopsis
- Estimation of depth of suppression
- Tests for microtropia
- Presence of anomalous retinal correspondence

INTERMITTENT DIVERGENT SQUINT
- Assess control of angle for distance and near
- Gradient AC/A ratio
- Fusion and stereopsis
- Convergence amplitudes for distance and near
- Monocular and binocular accommodative and vergence facility
Non-strabismic binocular vision anomalies (For e.g.: convergence insufficiency, accommodative insufficiency, and accommodative infacility)
- Detailed history specific to near visual activities, administration of symptom survey to quantify symptoms, detailed general health and medications history (H/O anaemia, thyroid dysfunctions, recent viral illnesses, Neurological illness, Head injury, psychogenic
illness, medications for seizures, psychogenic illness)
• Refraction
• Sensory and motor evaluation
• Horizontal and vertical phoria for distance and near
• Near point of convergence
• Fusional vergence for distance and near
• Vergence facility
• Near point of accommodation
• Accommodative responses using Monocular Estimate method Negative and Positive relative accommodation
• Accommodative facility

ACCOMMODATIVE ESOTROPIA
• Accommodative amplitudes
• Gradient AC/A ratio
• Response CA/C and AC/A ratio
• Near angles with and without addition
• MEM retinoscopy

ACCOMMODATIVE SPASM
• Refraction with and without cycloplegia
• Phoria/ tropia with and without cycloplegia
• AC/A ratio
• Cycloplegic and non-cycloplegic automated refraction measurements
• Biometry (To document axial length)
• Accommodation responses (to check lead of accommodation)
• Subjective acceptance with and without cycloplegic correction
• Progressive myopia
• Phoria for distance and near
• Gradient AC/A ratio
• Accommodative responses (to see if lag of accommodation is > +0.75 D)
• Near esophoria

NYSTAGMUS
• Assess the null point and AHP

• Adaptation with Yoke prisms
• Try Base out prisms for Nystagmus that dampens with convergence
• Binocular visual acuity with and without prisms
• AHP with and without prisms
• Photographic and video-graphic documentation

DIPLOPIA
• Magnitude of phoria/ tropia in all gazes for distance and near
• Hess/ Diplopia charting for Palsy and Paresis
• Vertical fusional reserves in congenital/ longstanding superior oblique palsy
• Compensatory fusional vergence reserves in intermittent squint
• Contact lenses for Anisometropia and reassess fusion
• Prisms for fusion
• Vision therapy to improve fusional vergence reserves in intermittent squint
• In Fresnel prisms, visual acuity with and without Fresnel prisms

HEAD INJURY (WITH NORMAL/ NEAR NORMAL VISUAL ACUITY)
• Accommodation and vergence
• Saccades and pursuits
• Reading parameters and eye movements assessment using Developmental eye movement test and Readalyzer Infrared eye movement tracking system
• Visual information processing assessment (Tests for visual perceptual skills)
• Prisms as field expanders in required cases
• Yoke prisms in reading difficulty/ hemianopia
• Learning related vision problems
• Review with recommendation from educational/school psychologist
• Visual information processing assessment (tests for visual perceptual skills)
• Accommodation and vergence testing
• Oculomotor testing (Saccades and Pursuits)
VISION THERAPY

- Home therapy/In-office vision therapy indicated for
- Non-strabismic binocular vision anomalies
- Amblyopia
- Intermittent squint
- Learning related vision problems

GOALS OF VISION THERAPY

- Anti-suppression
- Monocular accommodation, fixation and ocular motility training
- Gross vergence and training to appreciate physiological diplopia
- Smooth and jump vergence training
- Binocular accommodation training
- Visual information processing training
- Integration of procedures

PRESCRIPTION OF GLASSES IN CHILDREN

DECIDING FACTORS WHILE PRESCRIBING GLASSES

- Age of the child
- Visual needs
- Symptoms
- Strabismus
- Amblyopia
- Apkhakia/pseudophakia

MYOPIA

- Give full correction including cylinder
- Anisomyopia of more than 3D is amblyogenic
- Contact lenses, in high myopes, to avoid image minification may be prescribed in older children
- Avoid overcorrection of myopia in orthophoric children
- Do not prescribe myopic correction without a cycloplegic refraction
- Look for ocular or systemic causes in case of high myopia

HYPEROPIA

- Insignificant hyperopia i.e., upto +3.0, in the absence of esotropia or reduced vision, can be left uncorrected
- Hyperopia can be amblyogenic if:
  - At 0-1 years it is > 4D
  - At 1-2 years more than 3D
  - At 2-6 years more than 2D
- If there is an esodeviation full cycloplegic correction is prescribed
- Bifocals can be prescribed in case of high AC/A ratio

In school-going children, less than full cycloplegic correction (reduce 1-2-D) could be prescribed, to avoid distance blur, even if there is esotropia. Hyperopia may be corrected, even if insignificant, if there is a strong family history of
accommodative esotropia.
In children <8 yrs, cycloplegic acceptance can be prescribed.

**ASTIGMATISM**
Astigmatism of more than 1.5D needs full correction.
Oblique astigmatism/astigmatism against the rule needs full correction.
Refine the cylinder using Jackson’s Cross Cylinder wherever possible.

**ANISOMETROPIA**
Significant degrees of anisometropia can cause amblyopia in the more ametropic eye.
It can occur with unilateral ocular problems like unilateral aphakia, unilateral congenital glaucoma and ptosis.

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**Consensus guidelines for prescribing eye glasses in young children**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Diopter</th>
<th></th>
<th>Age 0-1 year</th>
<th>Age 1-2 year</th>
<th>Age 2-3 year</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Isometropia</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Myopia</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyperopia (manifest deviation)</td>
<td>≥ + 3.00</td>
<td>≥ + 2.00</td>
<td>≥ + 1.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyperopia (no deviation)</td>
<td>≥ + 6.00</td>
<td>≥ + 5.00</td>
<td>≥ + 4.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astigmatism</td>
<td>≥ 3.00</td>
<td>≥ 2.50</td>
<td>≥ 2.00</td>
<td></td>
<td></td>
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<tr>
<td><strong>Anisometropia</strong></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Myopia</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>≥ -2.50</td>
<td>≥ - 2.50</td>
<td>≥ - 2.00</td>
<td>≥ -1.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hyperopia</td>
<td>≥ + 2.50</td>
<td>≥ + 2.00</td>
<td>≥ +1.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astigmatism</td>
<td>≥ 2.50</td>
<td>≥ 2.00</td>
<td>≥ 2.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**APHAKIA**
Unilateral aphakia should be corrected with contact lens with add for near work. Upto two and a half year single vision glasses and bifocals later Bilateral aphakia should be corrected with glasses or contact lenses.
CONTACT – LENS (CL) REFERRAL AND PRESCRIBING GUIDELINES IN CHILDREN

INDICATIONS
- Refractive errors: Improves effective power, clarity of vision:
  - Myopia
  - Hyperopia
  - Astigmatism
  - Aphakia
- Corneal scar – vision improvement
- Corneal dystrophies and degenerations – vision improvement
- Anisometropia – vision improvement, diplopia management and avoiding amblyopia, given along with patching therapy
- Amblyopia - vision improvement, diplopia management and avoiding amblyopia, given along with patching therapy

PROCEDURES FOLLOWED IN THE CONTACT LENS PRESCRIBING
- Counseling parents about need for contact lens care and maintenance
- Cycloplegic refraction
- Evaluation of anterior segment - evaluate for corneal staining, suture if any
- If loose sutures or staining present- remove the loose sutures and treat corneal abrasions before CL trial
- Horizontal Visible Iris Diameter (HVID)
- Lid tone
- Keratometry –under sedation or under GA for infants and uncooperative children
- Choice of lens decided as per the above preliminary evaluation and the available contact lens

PRESCRIBING FOR > 3 YEARS OLD
- Lens made for distance power
- Near add prescribed whenever necessary
- Six months follow-up advised
- On parent’s request or if clinically recommended, soft or soft toric can be tried

General Note:
- Patients are referred with contact lens for squint evaluation and diplopia evaluation whenever indicated
- Prescriptions for age group less than two year old babies valid for three to six months only
- For age group 2 - 18 prescriptions valid for 6-12 months only
- The choice of lens is usually advised as higher oxygen permeable and disposability in children. In case of RGP three to six months disposal recommended with proper care regimen

PRESCRIBING FOR BABIES LESS THAN TWO YEARS:
- First choice of lens - RGP extended wear 6o DK
- Patient’s parents are taught procedures how to insert, remove and clean the CL
- To insert CL when the baby is awake and remove just after sleeping, though it is an extended wear material
- Lens power is calculated from the cycloplegic retinoscopy value, 12 mm vertex conversion and intermediate distance. No add prescribed in case of aphakia
- Base curve is determined after keratometry and considering lens thickness
- Lens diameter 2mm less than HVID
- Review every three months
- Spare lenses dispensed to use in case of lens loss
AMBLYOPIA

DISEASE DEFINITION
Amblyopia is a unilateral or, less commonly, bilateral reduction of best-corrected visual acuity that cannot only and directly be attributed to the effect of a structural abnormality of the eye or the visual pathways. Amblyopia is caused by abnormal visual experience early in life resulting from one of the following:
• Strabismus
• Anisometropia or high bilateral refractive errors (ametropia)
• Visual deprivation

PATIENT POPULATION
• Children younger than six years are at highest risk for development of amblyopia as this is the age of plasticity. However, age up to 12 has been associated with development of amblyopia
• Goals
• The goals of the patient care process are as follows:

PREDICT DISEASE
• Identify children at risk

DIAGNOSE
• Examine and diagnose the child with amblyopia or risk factors for amblyopia at the earliest possible stage
• Identify etiology of amblyopia and formulate an appropriate treatment plan

INFORM
• Inform the family/caregiver of the diagnosis, treatment options, and care plan

TREAT
• Treat infants and children with amblyopia in order to improve visual acuity, facilitate the treatment of strabismus, and reduce the likelihood of vision-related disability

MONITOR
• Re-evaluate the patient and adjust the treatment plan as necessary

DIAGNOSIS

HISTORY
Although a thorough history generally includes the following items, the exact composition varies with the patient’s particular problems and needs:
• Demographic data, including identification of parent/caregiver, and patient’s gender and date of birth
• Documentation of identity and relationship of the person from whom history is sought
• The identity of other pertinent health care providers
• The chief complaint and reason for the eye evaluation
• Current eye problems
• Ocular history, including prior eye problems, diseases, diagnoses, and treatments
• Systemic history; birth weight; prenatal and perinatal history that may be pertinent (e.g., alcohol, tobacco, and drug use during pregnancy); past hospitalizations and operations; general health and development
• Current medications and allergies
• Family history of eye conditions and relevant systemic diseases
• Review of systems

EXAMINATION
• The eye examination consists of an assessment of the physiological function and the anatomic status of the eye and visual system. Documentation of the child’s level of cooperation with the examination can be useful in interpreting the results and in making comparisons among the examinations over time. In general, the examination may include the following elements:
• Assessment of visual acuity and fixation pattern
• Ocular alignment and motility
• Red reflex or binocular red reflex (Brückner) test
• Pupil examination
• External examination
• Anterior segment examination
• Cycloplegic retinoscopy/refraction
• Funduscopic examination
• Binocularity/stereoaucity testing
• Assessment of Visual Acuity and Fixation Pattern

The method of evaluating visual acuity varies according to the child's age and level of cooperation. Preverbal children should be checked for objection to cover and the presence of a fixation preference.

When possible, monocular distance visual acuity should be determined utilizing a recognized optotype, such as the tumbling-E, Lea figures, or Snellen letters.

Anomalous head posture is suggestive of peeking around the occluder. An occlusive patch over the non-tested eye can distinguish between peeking and possible eccentric fixation.

Monocular visual acuity testing for patients with nystagmus may require blurring of the contralateral eye with a high plus lens (+4.00 D to +5.00 D). Binocular and monocular testing also should be performed for patients with nystagmus.

Testing visual acuity with isolated targets (figures or letters) is the quickest way to assess the vision in preverbal children. But it does lead to falsely elevated visual acuities. Isolated acuities should be compared with visual acuities taken with linear targets or crowding bars. The difference between linear and isolated acuities should be noted at each visit, if possible. This difference is a way of quantifying the depth of amblyopia from visit to visit.

Under ideal circumstances, visual acuity testing conditions should be standardized in each examination room and at each visit, so that the same viewing distance and lighting conditions are used. Some children are more amenable to testing at shorter distances.

The testing distance, type of optotype, and whether the optotype is presented as a line at a time or isolated, should be documented. Patients should be encouraged to learn optotype-equivalent tests at the earliest possible age.

**OCULAR ALIGNMENT AND MOTILITY**

Ocular alignment is assessed by using the corneal light reflection, the binocular red reflex (Brückner) test, or the cover test. Ocular versions and ductions should be tested even in the young infant. In the inattentive or uncooperative patient, eye movements may be tested using the oculocephalic rotations maneuver (doll’s head) or assessed by spontaneous eye movements.

**RED REFLEX / BINOCULAR RED REFLEX (BRÜCKNER) TEST**

The red reflex and/or binocular red reflex test should be performed to identify opacities of the ocular media.

The red reflex of each eye is assessed by looking at each eye with a direct ophthalmoscope from a distance of about 18 inches. The examiner should answer three questions:

1. Is there a red reflex from each eye?
2. Are the red reflexes from each eye symmetrical?
3. Is the quality of the red reflex normal for the individual child (taking into account skin tone and race or ethnicity)?

The binocular red reflex (Brückner) test allows an assessment of the clarity of the visual axis and an indirect assessment of ocular alignment as well as large and/or asymmetric refractive errors. The binocular red reflex test is performed in a dimly lit room with the examiner at a distance of about 30 inches (0.75 meter) from the child.

The examiner overlaps both pupils simultaneously, creating a binocular red reflex with the largest circular light of a direct ophthalmoscope set to focus on the ocular surface, usually at zero. The examiner then assesses the quality of the redness seen within the child’s pupils. Normally, the red reflex from each eye should be of the same color.
and brightness. Abnormalities include asymmetric reflexes when one reflex is duller or a different color, a white reflex, a partially or totally obscured reflex, or crescents present in the reflex.

**PUPIL EXAMINATION**

Even in small infants, the pupils should be assessed for direct and consensual response to light and for the presence of a relative afferent defect.

This can be done with a penlight, a direct ophthalmoscope, or a transilluminator. Pupil evaluation in infants and children may be difficult due to active hippus or shift in the patient’s fixation and accommodative status. In general, amblyopia is not associated with a detectable afferent pupillary defect.

**EXTERNAL EXAMINATION**

External examination involves assessment of the eyelids, eyelashes, lacrimal apparatus, and orbit. The anatomy of the face (including the lids, interocular distance, and presence or absence of epicanthal folds), orbital rim, and presence of oculofacial anomalies should be noted.

The position of the head and face (including head tilt or turn) should be noted. Children with prominent epicanthal folds and normal ocular alignment may appear to have esotropia (pseudo-esotropia). Distinctive features unusual for the family may suggest the presence of a congenital anomaly and merit an assessment of other physical abnormalities (e.g., ears, hands).

**ANTERIOR SEGMENT EXAMINATION**

To evaluate further opacities of the ocular media, the cornea, anterior chamber, iris, and lens should be evaluated with slit-lamp biomicroscopy, if possible. Slit-lamp biomicroscopic evaluation is indicated for older children or for younger children who are cooperative. In infants and young children, a hand-held slit-lamp biomicroscope may be helpful. Some children may need to be restrained, sedated, or undergo an eye examination under general anesthesia when apparent abnormalities warrant a detailed examination.

**CYCLOPLEGIC RETINOSCOPY/REFRACTION**

Determination of refractive errors is important in the diagnosis and treatment of amblyopia or strabismus. Patients should receive an accurate cycloplegic refraction either by retinoscopy or by subjective refraction. Prior to cycloplegia, dynamic retinoscopy provides a rapid assessment of accommodative function and may be helpful in evaluating a child with high hyperopia or possible accommodative insufficiency.

**FUNDUSCOPIC EXAMINATION**

Posterior segment structures should be examined, preferably with an indirect ophthalmoscope. The optic disc, macula, retina, vessels, and the choroid of the posterior regions should be examined. Examination of the peripheral retinal and scleral indentation, if indicated, may require sedation or general anesthesia (e.g., evaluation for retinoblastoma).

**BINOCULARITY / STEREACUITY TESTING**

Testing for binocular fusion (e.g., Worth 4-dot test) or the presence of stereopsis (e.g., Random-Dot E test or Stereo Fly test) may be useful in detecting ocular misalignment or amblyopia. Fusion and stereocuity testing at distance (20 feet or 6 meters) as well as near (13 inches or 0.33 meter) may also be helpful.

**CRITERIA FOR DIAGNOSIS**

Amblyopia in the absence of strabismus, unequal refractive error, or media opacity is rare. A careful search for an alternate diagnosis with associated visual loss should be carried out if an obvious cause is not present. Amblyopia is diagnosed when the criteria in Table 1 are met and the cause is identified (Table 2).

**MANAGEMENT**

In managing amblyopia, the ophthalmologist strives to improve visual acuity by using two basic strategies. The first is to present a clear retinal image to the amblyopic eye by eliminating causes of visual deprivation and correcting visually important refractive errors.

The second strategy is to make the child use the amblyopic eye. While not always achievable,
the treatment goal is to achieve equalization/normalization of fixation patterns or visual acuity.

Child wearing an indigenously prepared patch

The recommended treatment should be based on the patient's age; visual acuity; compliance with previous treatment; and physical, social, and psychological status.

**CHOICE OF THERAPY**

The following therapies are used alone or in combination as required to achieve the therapeutic goal:

- Optical correction
- Occlusion
- Penalization
- Surgery to treat the cause of the amblyopia
- In the Amblyopia Treatment Study Group trials, mild to moderate amblyopia is defined as visual acuity in the amblyopic eye of 20/80 or better. Severe amblyopia is defined as visual acuity in the amblyopic eye of 20/100 to 20/400

**OPTICAL CORRECTION**

Refractive correction alone improves visual acuity in at least one-third of children three to seven years old with untreated anisometropic amblyopia.

In some cases where amblyogenic risk factors are present (e.g., unilateral keratopathy, a small monocular cataract, or ocular conditions that can cause anisometropia such as unilateral ptosis and hemangioma), it may be useful to institute preventive therapy using eyeglasses to correct refractive error and/or occlusion therapy.

In general, eyeglasses are well tolerated by children, especially when there is visual improvement. Accurate fitting and maintaining proper adjustment facilitate acceptance. Straps may be useful in babies; cable temples and spring hinges are helpful in keeping eyeglasses on active young children. Polycarbonate lenses have greater safety and are preferable for children, especially if they are amblyopic.

Some children require optical correction in conjunction with occlusion or penalization for effective amblyopia therapy. Refractive surgery is performed in some instances of anisomyopia associated with poor visual acuity.

**OCCLUSION**

The physiologic benefit of occlusion is that it produces the greatest decrease in neural signals from the dominant eye, as demonstrated by recordings from the visual cortex in experimental animals.

**TYPES OF OCCLUDERS**

1. Adhesive skin patch (self-made with micropore tape and tissue paper)
2. Commercially available opticlude
3. Doyen's occluder
4. Contact lens occluder

**OCCLUSION SCHEDULE**

Some practitioners believe that full-time occlusion of the nonamblyopic eye may improve visual acuity more rapidly than part-time patching.
However, recent Amblyopia Treatment trials have shown that 6 waking hours of prescribed daily patching produces an improvement in the visual acuity that is similar in magnitude to full-time occlusion therapy when treating severe amblyopia (worse than 20/80) in children under seven years of age. In children with moderate amblyopia (20/40-20/80), two waking hours of prescribed daily patching produces an improvement in visual acuity that is similar in magnitude to the improvement produced by six hours of prescribed daily patching.

ADJUSTMENT OF OCCLUSION

Children treated with full-time or near full-time occlusion may develop strabismus or occlusion amblyopia in the previously better-seeing eye. It is called reverse amblyopia. On the other hand, in some children, occlusion therapy may improve strabismus. Frequency of follow-up visits: as in Table 3.

WHAT TO LOOK FOR DURING FOLLOW-UP?

1. Visual acuity of both eyes on the same chart after giving 5-10 minutes for acclimatization
2. Fixation pattern
3. Presence of occlusion amblyopia

WHEN SHOULD OCCLUSION BE STOPPED?

1. When vision becomes equal in both eyes
2. When there is true alternation of fixation
3. No visual improvement after three to six months of occlusion despite good compliance.

FOLLOW-UP AFTER COMPLETION OF TREATMENT

1. Follow-up till twelve years of age.
2. Infants should be followed up every six weeks.
3. Children between three to six years should be followed every three months.
4. Children above six years should be followed up every six months.

Side effects of treatment are well known and usually mild and transient. Skin irritation can be minimized with commercial preparations, such as unscented skin cream, which can be applied to irritated areas when the child is not wearing the patch. The parent/caregiver should be advised that children wearing a patch should be monitored carefully to avoid accidents.

PENALIZATION

Penalization refers to a therapeutic technique performed by optically defocusing the eye with better vision by using cycloplegia or by altering the eyeglass lens to cause decreased vision in the nonamblyopic eye. This technique may be considered only for children with:

- Occlusion nystagmus
- Occlusion failures
- For children non compliant to occlusion therapy
- For children who require maintenance treatment

Penalization can be performed full time or part time. Penalization is not effective for children with severe amblyopia, who require occlusion.

In hyperopic patients and patients with mild myopia (i.e., less than or equal to –1.0 D), defocusing of the fixing eye may be achieved by using topically applied atropine, homatropine, or cyclopentolate. Atropine should be used with caution during the first year of life because of systemic side effects and the possibility of blur-induced amblyopia. Applying direct digital pressure over the lacrimal sac for 20 to 30 seconds may reduce systemic toxicity when using atropine and other cycloplegic agents.

In children who show no improvement with atropine or who do not tolerate patching or eye drops, optical penalization can be used. Optical penalization can be done by changing the refractive correction of the dominant eye to induce blur or by using translucent filters (such as frosted tape or Bangerter semi-translucent filters). The success of these techniques has been variable, and they have not been tested with randomized clinical trials.

SURGERY

Surgical procedures are recommended when the cause of the amblyopia can be attributed to a reparable opacification of the media, such as
cataract, non-clearing vitreous opacities, corneal opacities, or blepharoptosis, and are severe enough to prevent successful therapy without surgical correction. Although strabismus surgery may facilitate amblyopia management in selected cases, it usually does not eliminate the need for amblyopia treatment.

The role of refractive surgery in treating anisometropic amblyopia is controversial. Recent studies have shown that photorefractive keratectomy in non-compliant children with anisometropic amblyopia and LASIK in adults with amblyopia can be safely performed. Visual acuity and stereopsis have improved in most eyes, even in older children.

Opacification of the vitreous cavity from hemorrhage or inflammatory debris also can produce deprivation amblyopia and may necessitate vitrectomy. If subluxation of a clear lens causes significant optical defocus that is not correctable with eyeglasses or contact lenses, a lensectomy may be necessary.

- Drugs like Levodopa have not come into completely accepted treatment regimens

**MAINTENANCE THERAPY**

If maintenance therapy is advised, the child may participate in choosing the method. Maintenance methods include:

- Part-time patching
- Full or part-time optical penalization
- Full or part time cycloplegic penalization

When maximum visual acuity improvement has been obtained, or there is no improvement in vision despite fully compliant patching for three months, the treatment may be tapered and eventually stopped.

Patients who are functionally monocular should wear proper protective eyewear full time, even if they do not require corrective lenses. A frame approved by the American National Standards Institute Standard No. Z87.1 with polycarbonate lenses should be worn for daily wear and low-eye-risk sports. For most ball and contact sports, polycarbonate sports goggles should be worn, and head and face protection should be added for higher risk activities. Functionally monocular individuals should use approved protective eyewear when participating in contact sports or other potentially harmful activities, such as those that involve pellet guns, paintballs, and personal use of fireworks. Special goggles, industrial safety glasses, side shields, and full-face shields should be used in these cases. Functionally monocular patients should be aware of the need to have regular eye examinations throughout their lives.

**PREVENTION AND EARLY DETECTION**

All children should undergo eye and vision screening, because screening is most effective when performed periodically throughout childhood.

In addition, children with risk factors for amblyopia should have a comprehensive ophthalmic evaluation. Some risk factors include:

- Family history of amblyopia or strabismus
- Childhood cataract or glaucoma
- Premature birth of less than 30-week gestation

1,500 grams, and delayed visual or neurologic maturation of unclear etiology.

Reduction or prevention of risk factors such as premature birth and detrimental prenatal environmental influences such as substance abuse and smoking can result in a decrease in the incidence of amblyopia.

**COUNSELING AND REFERRAL**

Amblyopia is a long-term problem that requires commitment from the parent/caregiver and ophthalmologist to achieve the best possible outcome. The ophthalmologist should discuss the findings of the evaluation with the patient, when appropriate, as well as the parent/caregiver. The ophthalmologist should explain the disorder and recruit the family in a collaborative approach to therapy. Parents/caregivers of pediatric patients who understand the diagnosis and rationale for treatment are more likely to adhere to treatment recommendations.
### Table 1. Diagnostic criteria for Amblyopia

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Finding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unilateral Amblyopia</strong></td>
<td></td>
</tr>
<tr>
<td>Fixation preference</td>
<td>Unequal fixation behavior</td>
</tr>
<tr>
<td>Preferential looking</td>
<td>2-octave difference</td>
</tr>
<tr>
<td>Best corrected visual acuity</td>
<td>&gt;= 2-line interocular difference</td>
</tr>
<tr>
<td><strong>Bilateral Amblyopia</strong></td>
<td></td>
</tr>
<tr>
<td>Best corrected visual acuity</td>
<td>Vision&lt;20/40 in each eye</td>
</tr>
</tbody>
</table>

2-octave difference is a 4 card difference in the set of Teller Acuity Cards, which is equivalent to multiplying or dividing the visual angle by 4.

### Table 2. Causes of Amblyopia

<table>
<thead>
<tr>
<th>Unilateral Amblyopia</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refractive</td>
<td></td>
</tr>
<tr>
<td>Myopia</td>
<td>2.00-2.50 D interocular difference, depending on age</td>
</tr>
<tr>
<td>Hyperopia</td>
<td>1.50-2.00 D interocular difference, depending on age</td>
</tr>
<tr>
<td>Astigmatism</td>
<td>2.00-2.50 D interocular difference, depending on age</td>
</tr>
<tr>
<td>Visual deprivation</td>
<td>Ptosis, corneal scar/opacity, vitreous hemorrhage</td>
</tr>
<tr>
<td>Strabismus</td>
<td>Esotropia, exotropia, hypertropia</td>
</tr>
<tr>
<td><strong>Bilateral Amblyopia</strong></td>
<td></td>
</tr>
<tr>
<td>Refractive</td>
<td></td>
</tr>
<tr>
<td>Myopia</td>
<td>3.00-5.50 D interocular difference, depending on age</td>
</tr>
<tr>
<td>Hyperopia</td>
<td>4.50-6.00 D interocular difference, depending on age</td>
</tr>
<tr>
<td>Astigmatism</td>
<td>2.00-3.00 D interocular difference, depending on age</td>
</tr>
<tr>
<td>Visual deprivation</td>
<td></td>
</tr>
<tr>
<td>Bilateral ptosis</td>
<td>Severe bilateral</td>
</tr>
<tr>
<td>Bilateral corneal opacities</td>
<td>Tyrosinemia, corneal dystrophy, Peter’s anomaly, anterior segment dysgenesis, chronic inflammatory diseases, metabolic syndromes</td>
</tr>
<tr>
<td>Bilateral cataract</td>
<td>Sporadic, autosomal dominant, autosomal recessive</td>
</tr>
<tr>
<td>Bilateral vitreous hemorrhage</td>
<td>Trauma</td>
</tr>
</tbody>
</table>

### Table 3. Recommended Amblyopia follow-up evaluation intervals during active treatment period

<table>
<thead>
<tr>
<th>Patient age (years)</th>
<th>High percentage occlusion (70% or more of waking hours/≥6 hours/day)</th>
<th>Low percentage occlusion (&lt;70% or more of waking hours/&lt;6 hours/day)</th>
<th>Maintenance Treatment or Observation</th>
</tr>
</thead>
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<tr>
<td>0-1</td>
<td>1-4 weeks</td>
<td>2-8 weeks</td>
<td>1-4 months</td>
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<tr>
<td>1-2</td>
<td>2-8 weeks</td>
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<td>2-3</td>
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<td>4-5</td>
<td>4-16 weeks</td>
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<tr>
<td>5-7</td>
<td>6-16 weeks</td>
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<td>2-6 months</td>
</tr>
<tr>
<td>7-9</td>
<td>8-16 weeks</td>
<td>3-6 months</td>
<td>3-12 months</td>
</tr>
</tbody>
</table>

The prevalence of visual impairment, refractive errors and strabismus in children with developmental delay is markedly increased compared to that found in normal children. Of the refractive errors hyperopia, astigmatism, whereas myopia is low.
SEDATION PROTOCOL IN PEDIATRIC AGE GROUP

INDICATIONS
• Suture removal
• Change of eye-pad dressings
• Measurement of IOP
• Removal of IV access

ASSESSMENT
• Detailed history and physical examination
• Previous history of any sedation administered
• History of allergic to any medications

FASTING
• Two hrs NPO for clear fluids/solids etc
• Preparation of the child
• Consent for oral sedation
• Measure body weight
• Assess airway
• Emergency trolley with necessary drugs
• Suction apparatus with attachment
• Baseline measurement of HR/SaO2, respiratory rate and sedation score (see attached)
• Connect to pulse oximeter
• Agent used
• Syr. Pedicloryl 50mg/kg body weight (Triclofos Oral solution 500mg/5ml)
• Post-procedure
• Monitor and record vital signs every 15 minutes
• Child should be “left-lateral position” and nil per oral until the sedation score returns to baseline level

UMMS- THE UNIVERSITY MICHIGAN SEDATION SCORE
• Awake and alert
• Minimally sedated; may appear tired/sleepy, responds to verbal conversation and or sound
• Moderately sedated; somnolent/sleeping; easily roused with light tactile stimulation or simple verbal command - also known as “conscious sedation”
• Deep sedation; deep sleep, rousable only with deep or significant physical stimulation
• Unrousable

CHILD WITH DEVELOMENITAL DELAY

AIM OF EXAMINING A CHILD WITH DELAYED DEVELOPMENT
• Early detection to optimize their learning capacity and independence
• To find out the treatable causes of visual handicap in these children
• To study type of developmental delay whether
• Isolated or global delay and their appropriate referral
• For accurate health surveillance and educational planning for the child
• Identification of possible risk of having affected children in the future

HISTORY
• Detail history with regards to
• Birth history

PRENATAL HISTORY
• Potential teratogens including alcohol, medications, vitamins, maternal infection (rubella, cytomegalovirus, toxoplasmosis, varicella), maternal diabetes, hyperthermia, maternal phenylketonuria
• Prenatal tests (eg, amniocentesis, ultrasound)

PERINATAL HISTORY
• Gestation, mode of delivery, Apgar scores, resuscitation
• Birthweight, length, head circumference
• Feeding, muscle tone, other problems

POSTNATAL HISTORY
Milestones, school performance
Evidence of regression (this may be a clue to inborn error of metabolism or neurodegenerative process)
• Unusual behaviour, personality
• Coordination, seizures, unusual movements
• Increased or decreased tone
• Growth: height, weight, head circumference
• Previous illnesses
• Vision, hearing
• Immunization

FAMILY HISTORY
• Three generations, maternal and paternal
• Consanguinity
• Previous pregnancy outcomes: miscarriages, stillbirths, neonatal or childhood deaths, infertility
• Family history of birth defects, childhood deaths, mental retardation, speech delay, learning disabilities, autism and known genetic conditions

TREATMENT AND REHABILITATION HISTORY
Special School
• Physiotherapy or occupational therapy
• Visual stimulation exercise
• Medical or surgical treatment taken
• Physical examination

To classify the child into syndromic versus non-syndromic developmental delay
- To look in detail for minor anomalies, particularly of the face, head and hands.
- Try to first determine whether the child looks like either of the parents or siblings.
- Compare photographs of the siblings or parents at a similar age maybe useful as a comparison.
- To describe the features (eg, coarse, myopathic), or a more specific description of each feature is required (eg, hypertelorism,)
- Mongoloid and anti mongoloid slant, craniosynostosis etc
- A careful neurological examination is important
- Noting abnormalities of muscle tone and strength
- Carefully examining the skin for hyper- or hypopigmentation Café-au-lait spots may signal neurofibromatosis
- Vascular tumours or hemangiomas may suggest certain genetic disorders or syndromes
- Other unusual findings such as anomalies of the genitalia, connective tissue and/or joint abnormalities and internal anomalies (especially cardiac and renal) should be noted.
- A reference to pediatric for other systemic evaluation is mandatory

VISUAL ACUITY TESTING
In < 1 Year
• CSM
• Fixing and following light
• Indirect methods: red reflex, resisting to occlusion
  Flash VEP

1-2 Years
  Candy bead test
  Preferential looking tests
  Flash VEP

2-3 Years
  Sheridan gardner
  Assessment of functional visual acuity like reaching out to objects or toys, social smile, holding at toys, side gazes etc)

Ophthalmological conditions to look for
Refractive errors
• Most of these children are hypermetropics and hypo accommodators

Squint
• Exotropia is most commonly seen
• A careful surgical planning is required in these cases
• Complications of general anesthesia also to be kept in mind

Optic Atrophy
• Look for other neurological abnormalities

Delayed visual maturation
• Vision therapy exercises may help in these cases

Cortical Visual Impairment
Cortical visual impairment is a neurologic impairment defined as bilateral loss of central vision (visual acuity) caused by damage to the
central nervous system.
- Retinopathy of prematurity (ROP)
- Papilloedema
- Nystagmus
- Cataract

INVESTIGATIONS

GENETICS
- Karyotyping to assess for chromosomal abnormalities when necessary
- Endocrinology when necessary
- TSH, free T4
- Referral to endocrinology should be considered

METABOLIC
Metabolic screening – glucose, electrolytes, serum lactate, ammonia, liver function tests, pyruvate, albumin, triglycerides, uric acid, serum quantitative amino acids, urine organic acids, acylcarnitines, creatine phosphokinase (if suspecting myopathy)
- Referral to physician should be considered
- Neurology:
  - EEG
  - CT/MRI
  - Referral to neurology if any of these tests are considered

INTERVENTION

EARLY INTERVENTION
- Physiotherapy
- Occupation therapy
- Speech therapy
- Other service
- Psychologist
- Early childhood educator
- Behavioral therapist
- Pediatric

PHYSIOTHERAPY
- Achievement of physical milestones such as sitting, crawling and standing
- Improved independence in activities of daily living
- Improved posture, muscle strength, balance and coordination
- Verbal and non-verbal communication skill development
- Language understanding
- Social communication use (e.g., greeting people and playing with peers)
- Speech clarity (ability to produce and combine speech sounds)
- Fluency

OCCUPATIONAL THERAPY
- Improve trunk control
- Fine motor skills (hand function)
- Activities of daily living (e.g., dressing, feeding and swallowing)

VISUAL DEVELOPMENT THERAPY
The capacity of visual system can be improved through the presentation of specific material activities
It should go in systemic procedure to get desired visual behavior
Many children with neurological visual impairment develop higher level of vision after receiving visual development therapy

Level I
To be performed in a dark room
Phase 1- Light and white paper
Phase 2- Light and colored paper
Phase 3- Light with translucent plastic ball/toys
Phase 4- Move lighted objects across the line of sight

Level II
Perform the above phases in a room with normal lighting.

Level III
Perform the above phases with a bright shiny
object such as Christmas decorations or glittering papers in a room with low level lighting.

**Level IV**
Start using brightly colored large toys instead of lights or objects.

**Level V**
Show bright high contrast black and white patterns; followed by facial expression flash cards.

**VISION DEVELOPMENT**
Awareness > Attention > Understanding
Light > Object > People
Fixation > Tracking
Large > Small

**REHABILITATION & EDUCATION**
Parents should be guided to select the suitable medium and mode of education

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**NYSTAGMUS**

Repetitive, regular, rhythmic, involuntary, to-and-fro, oscillatory movements of the eyes

**TYPES**
- CEMAS classification
  - Idiopathic Nystagmus Syndrome (INS)
  - Fusional Maldevelopment Nystagmus Syndrome (FMNS) Names like INS not congenital nystagmus
- Other classifications:
  - Pendular
  - Jerk

**ETIOLOGICAL CLASSIFICATION**
- Physiological
  - Optokinetic nystagmus
  - End point nystagmus
  - Physiological vestibular nystagmus

**CONGENITAL**
- Infantile nystagmus
- Latent nystagmus
- Spasmus nutans
- Nystagmus blockage syndrome

**ACQUIRED**
- Acquired (Ocular) pendular nystagmus
- Peripheral vestibular nystagmus
- Central vestibular nystagmus
  - Upbeat
  - Downbeat
  - Periodic alternating nystagmus
- Gaze paretic nystagmus
- See saw nystagmus

**PRESENTATION**
- Visual acuity ranges from profound visual loss to minimal dysfunction
- Nystagmus
- Strabismus
- Photophobia
HISTORY
- What is the duration of diminution of vision?
- Is the diminution of vision slowly progressive?
- Is there any associated decrease in side vision?
- Is there any associated decrease in night vision?
- Is there any photophobia?
- Is there any strabismus?
- Is there any history of consanguinity amongst parents?
- Is there any family member affected?
- Is there any mental retardation/developmental delay?
- Are there any other systemic abnormalities?
- Is there any history of taking medications?

EXAMINATION
- Abnormal head posture
- Null point
- Abnormal head movements
- Head bobbing
- Systemic anomalies
- Neurological anomalies
- Visual acuity and refraction
- Binocular function testing + sensory evaluation
- Color vision
- Extraocular movements and associated strabismus
- Evaluation of nystagmus
  - Type (Jerk/Pendular)
  - Unilateral/Bilateral and symmetrical/asymmetrical
  - Direction (horizontal, vertical, torsional)
  - Whether uniplanar or multiplanar?
  - Frequency
  - Amplitude
  - Null point
  - Saccades and pursuits
- Pupil evaluation
- Slit lamp examination
  - Cornea - opacities
  - Iris – transillumination defects, aniridia
  - Lens – congenital cataract
- IOP
- Fundus
- Indirect ophthalmoscopy with 20 D and 78D
  - Disc: Optic disc anomalies
  - Arteries: Attenuation, abnormal orientation (Morning glory syndrome)
  - Macula: Foveal hypoplasia, albinism
  - Periphery: Depigmented, retinochoroidal abnormalities Cone Rod dystrophies ROP

INVESTIGATIONS
- If you suspect ocular anomaly as the cause for nystagmus
- Investigations mainly to confirm the diagnosis
  - OCT
  - ERG
  - VEP
- Acquired nystagmus associated with oscillopsia/vertical torsional/multiplanar
- Suspect CNS abnormality
- Neuroimaging
  - MRI
  - CT

TREATMENT
- Glass prescription
- Optical management
  - Overminus lens
  - Prisms- yoked prisms or base out prisms
  - Contact lens
- Concomitant amblyopia treatment
- Low vision aids
- Medications
  - Baclofen
  - Gabapentine
  - Botox
- Surgical correction for associated strabismus
- Surgical management of nystagmus
- Kestenbaum-Anderson procedure
  - Artificial divergence surgery
  - Retroequatorial recession of horizontal recti
  - Anterior tenotomy and reattachment
- Neurosurgery
- Systemic examinations
• Genetic counseling
• Advise ocular examination of other family members
• Do not give a very poor prognosis to the patients, emphasize on the positive side - the patient is very unlikely to be completely blind
• Routine monitoring every year or as and when required to treat the complications associated with the disease
• Rehabilitation
• Information about new scientific developments

EPIPHORA

COMMON CAUSES
• Congenital Naso-lacral Duct Obstruction (Most common)
• Vernal/allergic conjunctivitis
• Ophthalmia neonatorum
• Congenital Glaucoma

DIFFERENTIAL DIAGNOSIS
• Ophthalmia neonatorum
• In first month of life
• Conjunctival hyperaemia, copious discharge
• Needs immediate attention

CONGENITAL NASO-LACRIMAL DUCT OBSTRUCTION
• Epiphora usually after one month of birth as there is no lacrimal secretion earlier than that.
• Clear serous, mucoid or mucopurulent discharge specially if superadded infection
• There is regurgitation of discharge from punctum on digital pressure over lacrimal sac area (ROPLAS- Regurgitation on pressure from lacrimal sac)
• May have associated episodes of dacrocystitis
• Dacryocoele may also be present which decreases after pressure over cyst, with discharge through punctum

LACRIMAL PUNCTUAL ATRESIA
• Overflow of clear tears
• No regurgitation on pressure over lacrimal sac area

CONGENITAL GLAUCOMA
Epiphora is usually accompanied with following:
• Photophobia
• Blepharospasm
• Megalocornea
• Corneal haze
• Blue sclera
• Haab’s striae

VERNAL/ALLERGIC CONJUNCTIVITIS
• Seasonal waxing and waning of episodes
• Severe itching and rubbing
• Ropy discharge
• Conjunctival pigmentation
• Cornea may have SPKS, shield ulcers in severe cases
• Often have associated atopy

CLINICAL EXAMINATION
HISTORY
• Onset
• Associated symptoms
• History of prematurity
• Family history

OPHTHALMIC EXAMINATION
• Fixation preference for any eye
• Always rule out refractive error by cycloplegic refraction
• CNLDO is commonly associated with refractive errors and amblyogenic factors like strabismus and anisometropia

CLINICAL EXAMINATION
• Look for punctal atresia or agenesis, note punctal apposition also
• Look for lacrimal sinus or fistula
• Anterior segment examination with slit lamp or hand held slit lamp.
• Can use Indirect ophthalmoscope with 20 D lens for magnification if handheld slit lamp not available.
• Look out for foreign body, caterpillar hair if epiphora is unilateral by everting the lid. Double eversion may require short GA
• Ophthalmia neonatorum, if suspected, should be dealt on emergency basis
• Glaucoma also needs early intervention and treatment so attempt should made to check IOP either under sedation or general anesthesia
• Corneal surface abnormalities
• Digital pressure on sac area to test if any regurgitation
• Fundus evaluation is mandatory

INVESTIGATION
• It is useful to plan evaluation under anesthesia if cause of watering is not clear on clinical examination
• DCG, Dacrocystography, to find out exact site of obstruction.
• Nasal endoscopy if bony obstruction suspected or to rule out antecedent nasal pathology

MANAGEMENT

OPHTHALMIA NEONATORUM
• Prevention: Prophylactic application of Erythromycin eye ointment or Povidone iodine eye drops in both eyes immediately after birth in both eyes
• Antibiotic treatment needs to be started immediately
• In case of gonococcal infection, require oral antibiotics

GLAUCOMA
• Discussed in detail in glaucoma section

ALLERGIC CONJUNCTIVITIS
PREVENTION
• Protective glasses
• Avoid pets, dust, travelling in a window seat
• Hand hygiene
• Mast cell stabilizers (Cromolyn sodium four%) can be started one to two weeks if a definite waxing period is noted over the years

TREATMENT
Mast cell stabilizers: They act by preventing the degranulation of the mast cells.
• Olopatadine one% twice a day or two% once a day
• Cromolyn sodium one%
• Ketotifen fumarate (0.025%)

**Steroids:** It depends upon severity of the symptoms. Presence of corneal involvement is an indication for steroids. If steroids are indicated, a short tapering course of low dose steroids can be prescribed. Take few minutes to explain potential adverse effects like glaucoma to parents. This will prevent self medication.
• Flurometholone one%
• Prednisolone acetate

**Immunomodulators**
• Tacrolimus ointment over the lid

**Lubricants**
• They help in maintaining ocular surface integrity. Patients with chronic allergic condition often develop secondary dry eye

**Follow up**
• These children need regular follow up to detect any glaucomatous changes, limbal stem cell deficiency or cataractous changes in lens

**CONGENITAL NASO-LACRIMAL DUCT OBSTRUCTION**

**Duct Obstruction**
• Conservative
• Criggler’s massage:
  • Appropriate technique is of utmost importance.
  • Press with little finger above medial canthus area and massage downwards, backwards and medially with same force throughout.
  • 20 strokes three times a day at least for six weeks. To be continued till the duct becomes patent or child is one year old whichever is earlier.
  • To be continued for two months even if ROPLAS becomes negative.
• Lid hygiene
• Antibiotic eye drops can be prescribed if there is a superimposed infection leading to profuse mucoid or mucopurulent discharge

**PROBING AND SYRINGING**

**After one year of age**
• Indication for early probing:
• If child needs intraocular surgical intervention earlier. For e.g. glaucoma, cataract
• Acute dacrocystitis causing fistula

**Procedure**
• We prefer general anesthesia, can be done as in office procedure under topical anesthesia but not recommended in older children
• Dilatation of puncti with punctum dilator
• Lacrimal sac irrigation by syringing through lower puncta
• Surgeon should proceed with probing even if syringing is patent
• Bowman probe 0 or 1 first advanced vertically in punctum
• Traction over lateral canthus with finger
• Probe will become horizontal and then passed towards sac area. Look for any obstruction, resistance
• If resistance felt, smaller size probe inserted to rule out stenosis Vs obstruction
• If resistance felt gradually increasing force can be applied to clear obstruction or stenosis
• When tip encounters nasal bony wall, retract a probe a little and pivot to direct it downwards, medially. Remove lid traction at this point.
• Sudden decrease in resistance is felt if there is distal membranous obstruction which got overcome
• Put one more probe in nasal cavity below inferior turbinate and look for any movement in primary probe
• Can be confirmed by repeating syringing.
• If firm or hard resistance felt, then its either because of hypertrophic inferior turbinate or bony ostium
• Can try infracture of inferior turbinate in such cases

**Post op care**
• Antibiotic and steroid drops for a week
• To continue Criggler’s massage for 2 weeks
• Complications:
  • Minor nasal bleeding
  • Creation of false passage
  • Failure
  • Recurrence commonly within 2 months

**If probing fails or recurrence occurs**

• Repeat probing can be done after 2 months with inferior turbinate infracture in other cases
• Balloon dilatation or intubation can be used
• In cases of bony ostium no role of repeat probing
• If repeat probing fails or in cases of bony ostium:
  • Can wait and watch till 2 years as bone development is complete
  • Periodic follow ups
  • Dacrocystorhinostomy is indicated
  • Decision of timing depends upon severity of signs and symptoms

**Punctal stenosis/atresia**

• Punctal perforation with 26G needle with punctal dilatation is sufficient in most cases
• If not successful for maldeveloped puncta may need incisional punctoplasty with/ without intubation
• Conjunctivo-dacro-cysto-rhinostomy if no punctum

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**STRABISMUS - COMITANT**

**INTRODUCTION**

Strabismus is a common condition in childhood affecting 2.1% of the population, with an increased prevalence associated with assisted delivery (forceps or caesarean section), low birth weight (including premature infants), neuro-developmental disorders. Neuro-developmental strabismus (associated with a neuro-developmental problem) is independently associated with maternal smoking later in pregnancy, maternal illnesses in pregnancy and low birth weight for gestational age.

Approximately 60% have eso-deviations and 20% exo-deviations.

Strabismus may lead to a failure to develop binocular vision, and amblyopia, either of which may prevent an individual pursuing certain occupations. The appearance of ocular misalignment may interfere with social and psychological development with potentially serious effects for all patients with strabismus.

Timely diagnosis and appropriate treatment of children with strabismus can reduce the prevalence of amblyopia and ocular misalignment in later childhood and adult life. Correction of strabismus has been reported to improve motor coordination.

Strabismus may be the presenting symptom in children with a serious eye or brain condition (e.g. retinoblastoma, hydrocephalus or brain tumour). All professionals involved with the management of strabismus need to be able to recognize this, and either initiate onward referral or arrange for appropriate investigation and management.

**AIMS OF MANAGEMENT OF STRABISMUS**

• To maintain or restore optimal visual acuity in each eye
• To maintain or restore normal (or subnormal) binocular single vision
• To restore appropriate ocular alignment
• To eliminate double vision or other induced symptoms (e.g. asthenopia)
• To correct significant abnormal
(compensatory) head posture
• To improve binocular visual field (in the case of esotropia correction)
• To detect/exclude serious underlying ocular or neurological disease

CONCOMITANT SQUINT

HISTORY
• Age of onset of squint
• Precipitating factors like trauma, febrile illness.
• Associated abnormal eye movements or abnormal head position
• Symptoms of asthenopia
• Double vision
• Eye closure in bright light
• Previous surgery for strabismus
• Occlusion therapy and compliance
• Previous spectacle wear
• Application of drops like phospholine iodide
• Any other surgery like R.D, cataract, glaucoma implant, sinus surgery or neuro surgery

BIRTH AND MEDICAL HISTORY
• Significant antenatal history
• Maternal infection, any drugs taken during pregnancy
• Any untoward event during delivery
• Birth trauma, forceps, birth asphyxia
• Gestational age
• Birth weight of the child
• History of being kept in incubator
• History of oxygenation
• Developmental milestones, both physical and mental
• Any associated systemic problem
• Other associated neurological problems like cerebral palsy, epilepsy, mental retardation and craniofacial anomalies
• History of any other handicap

FAMILY HISTORY
• Consanguinity
• Similar problems in other siblings
• History of any inherited eye or systemic condition
• Response of other members of family to surgery
• High ametropia

EXTERNAL EXAMINATION
• Shape of head
• Facial asymmetry
• Dysmorphic facial features like sparse hair, frontal bossing
• Ear abnormalities
• Any other deformities like extra digits
• General appearance including obesity

EXAMINATION
• Sensory evaluation has to be done before motor evaluation
• Binocular vision assessment
• Check binocular sensory status

Fusion – Worth 4 dot test for distance and near

Stereopsis – use Titmus fly/Lang’s chart/TNO

Retinal correspondence – use Bagolini’s glasses/Worth four dot test/Synaptophore

Suppression – Worth four dot test/Bagolini’s glasses
• Motor fusion can be assessed using the 20 base out test in preverbal children, and more formally in older children in a step wise manner using a prism bar/loose prisms and red filter
• Note any abnormal head posture like head tilt, face turn etc
• Assess lid position – Note any ptosis, lid retraction

OCULAR ALIGNMENT/ MOTOR EVALUATION

QUALITATIVE TESTS
• Do a cover test, cover uncover and alternate cover test for distance and near targets
(accommodative target must be used to increase accommodative stimulus)

- It is important to note if there is any fixation preference and the degree of control (if present)

**QUANTITATIVE TEST**

- Measure angle of deviation near and distance, with and without glasses using alternate prism cover test (APCT) and simultaneous prism cover test (SPCT)
- Measure angle of deviation in all gazes with correction
- Hirschberg’s test and modified Krimsky in case of uncooperative patients and those with poor fixation/vision
- Note A or V or X pattern and DVD if any
- The presence of any torsion can be assessed using a double Maddox rod, single Maddox rod and fundus examination
- Note any nystagmus – in primary position and other gazes
- Mention type of nystagmus, jerk or pendular, mention amplitude and frequency, note null point if any or if it dampens on convergence
- In children with nystagmus particular attention should be given to the visual acuity with both eyes open, near visual acuity (with both eyes open), fusion and any compensatory head posture to aid surgical planning

**VISUAL ACUITY ASSESSMENT**

**RECORD VISUAL ACUITY FOR NEAR AND DISTANCE**

Fixation pattern may be used as a gross comparison between the two eyes where formal testing is not possible. The two eyes can be separated using a vertically acting 10 or 12 dioptre prism (usually held base down). This is only necessary if there is no strabismus or the angle of strabismus is very small. A fogging lens (for example a plus lens) can be used instead of occlusion in the assessment of children with manifest or latent nystagmus. It is preferable to use a crowded test as early as possible for accurate detection of amblyopia. Near chart letter matching may be a more appropriate measure of near acuity than reading text, if children are still learning to read.

**DO RETINOSCOPY AND SUBJECTIVE REFRACTION**

Retinoscopy is carried out in a semi-darkened room using hand-held lenses, or trial frame, to neutralise the retinoscopic reflections along the visual axis. It is important to maintain the child’s attention and fixation should be on the retinoscope light.

It is rarely necessary to perform an examination under anesthesia in order to carry out refraction and fundus examination and its routine use should be discouraged.

A repeat refraction every 12 months is advised. If visual acuity fails to improve or deteriorates, it may be necessary to repeat the refraction, (along with a repeat fundus examination) or consider alternative diagnoses.

**DO CYCLOPLEGIC REFRACTION**

- A post cycloplegic subjective refraction is a useful exercise in selected cases.
• Adequate cycloplegia for retinoscopy may be obtained 30 minutes following the instillation of cyclopentolate one% eye drops.

• Below the age of six months mydriatics are used in lower concentration to reduce the risk of toxicity

• Cycloplentolate 0.5%

DECISIONS BASED ON VISUAL ACUITY

• Treatment with glasses

• Amblyopia therapy (occlusion, penalization)

• Frequency of follow up visits

• Consideration for further investigations

• Timing of strabismus surgery

ADDITIONAL TESTS

If indicated, measurement of AC/A ratio, ∆∆B O test, simultaneous prism cover test, fusional amplitudes, forced duction test, ERG. Use of the fixation circle in an ophthalmoscope can identify foveal fixation, or lack of it, which is particularly helpful in microtropia.

ANTERIOR SEGMENT EXAMINATION

BY SLIT LAMP/TORCH LIGHT

• Note any congenital anomalies like aniridia, coloboma, heterochromia, cataract

• Check pupillary reaction

FUNDUS EXAMINATION

Includes examining optic nerve and quality of the nerve fibre layer, macula and retinal periphery. The use of the indirect ophthalmoscope is recommended as standard in small children (less than five years).

In older children, the direct or 90 dioptre/slit lamp examination can add information.

If restraint is required, this is permitted to allow fundus examination to exclude life threatening examination findings such as papilloedema or optic atrophy. Parents should be requested to consent to have their child restrained.

If the examination is inadequate for any reason, the difficulty in the examination should be documented and a date set for a repeat examination.

EXAMINATION

Order of Management

1. Refractive error correction
2. Amblyopia treatment
3. Strabismus management

CORRECT REFRACTIVE ERROR

BY APPROPRIATE GLASSES

• Children's spectacles should always be provided with plastic lenses to reduce the risk of injury. Advise careful fitting, using adequate support for the nasal bridge and sufficient size of lens to avoid children looking over the top of the glasses

• In all forms of esotropia, full correction of hypermetropia is the treatment of choice (having corrected the retinoscopy for working distance only). This is often known as the 'full correction'. There is no requirement to subtract any lens power for cycloplegia

• In exotropia, uncorrected hypermetropia might be preferable to aid exotropia control, assuming visual acuity is good

• The main aims of further review are to further diagnose and classify the strabismus, monitor visual development (visual acuity and binocular function), treat amblyopia and manage the strabismus to obtain, maintain or restore binocular single vision where potential is present (e.g. prisms, alteration of / or addition of lenses, exercises)

• A period of refractive adaptation is recommended after glasses have been prescribed, until the vision is stable, as the visual acuity can improve with glasses alone, even in strabismic amblyopia. This may take up to 18 weeks

• The frequency of follow up visits will depend on many factors, such as age and change in treatment and treatment effect

• An annual refraction is required to monitor changes in the glasses prescription. An earlier repeat is indicated if the vision fails to improve
in what would be an expected way (for example with compliant occlusion), the visual acuity is worse with the spectacles, or there is a small residual esotropia

**MANAGE AMBLYOPIA BY OCCLUSION REGIMEN**

Occlusion - By a patch or frosted glasses depending on the visual acuity level, presence of binocularity and compliance
Part time two hours - mild amblyopia, for maintenance after discontinuing full time occlusion
Part time three to four hours – moderate amblyopia
Part time four to six hours – severe amblyopia
Follow up patients every three to four months for part time occlusion.

Further treatment of any residual strabismus that persists (despite the correct glasses and following amblyopia treatment) may be indicated to improve appearance and increase the potential for binocular development. Treatment is usually surgical.

Many factors influence the ease with which assessment is achieved. These include comfortable surroundings in waiting and play areas for children and their attendants, minimal delay in seeing the clinician and a friendly, professional approach by staff to the parents and child.

It is important to be able to maintain the child's attention for examination; especially if accurate retinoscopy is to be achieved. It is helpful to have easy control of the lighting in the examination room to prevent distraction and to have access to a variety of toys and/or pictures or TV screens to attract visual attention.

**SURGERY**

Plan surgery, if indicated, only when vision has equalized or there is spontaneous good alternation, or if there is no improvement in vision even after a full aggressive trial of amblyopia therapy.

**GENERAL GUIDELINES FOR MANAGEMENT OF DIFFERENT TYPES OF CONCOMITANT STRABISMUS**

**INFANTILE ESOTROPIA**

**Definition:** An esotropia that is constant by six months of age.

**Alternative Terminology:** Congenital Esotropia; Essential Infantile Esotropia.

**Incidence:** Estimates vary from 8% of childhood esotropia 11 and 1 in 400 live births.

**Age:** Onset before six months of age.

**Underlying Cause:** Idiopathic (Unknown)

**Presenting Scenario:** Parents/caretakers see inwardly turned eye from an early age.

**Classic Findings**
- Good visual acuity each eye (in the majority of cases)
- Amblyopia 13-33%
- Binocular vision absent
- Refractive error uncommon
- Large angle of esotropia
- Cross fixation
- Asymmetrical opto-kinetic response
- Latent nystagmus
- Over elevation in adduction (develops later)
- Dissociated vertical deviation (develops later)

Child with infantile esotropia showing inferior oblique overaction in right eye
DIFFERENTIAL DIAGNOSIS
• Early onset accommodative esotropia
• VI nerve palsy
• Duane syndrome
• Nystagmus block esotropia
• Sensory esotropia

TREATMENT AIMS
• Correction of amblyopia
• Surgically align eyes
• Development of binocularity (normal or subnormal)
• Correction of persistent over elevation in adduction and “V” pattern
• Treatment of DVD
• Plan surgery early, eyes should be aligned by age 24 months to optimize binocular cooperation
• Ensure free alternation before surgery
• Goal of treatment is alignment within eight prism diopter of orthotropia with atleast peripheral fusion
• Do bilateral medial rectus recession according to angle of deviation with inferior oblique
• Weakening procedures if there is associated inferior oblique overaction
• Follow up at six weeks and every six months.

CONTROVERSIES
- Definition: some use an esotropia by 12 months of age
- Effect of surgery on prevalence of amblyopia
- Age at surgery
- Indications for toxin
- Surgical Procedure: Bilateral medial rectus recession versus unilateral medial rectus recession and lateral rectus resection
- Two or three muscle surgery

ACCOMMODATIVE ESOTROPIA
Definition: An esotropia that is acquired, is either constant or intermittent (before treatment), which is straightened by correcting the associated hypermetropia.

Alternative Terminology: Refractive accommodative esotropia
Incidence: 36.4% of childhood esotropia
Age: Onset usually between ages 2-5 years old
Underlying Cause: Uncorrected hypermetropia
Presenting Scenario: Parents see inwardly moving eye when tired or concentrating on objects close by. Children occasionally exhibit signs of distress when the eye is squinting.
Classic Findings:
- Good vision in each eye (at time of onset of strabismus)
- Development of amblyopia over time (if uncorrected)
- Hypermetropia (usually more than +2.0 D)
- Esophoria or esotropia
- Normal AC/A ratio
- Family history often present

Restoration of binocular single vision with spectacle correction Or may control to a microtropia
DIFFERENTIAL DIAGNOSIS
- Non accommodative esotropia
- Constant esotropia (binocularity not re-established with spectacle correction)
- Also known as partially accommodative esotropia or constant esotropia with an accommodative element
- VI nerve palsy
- Congenital esotropia
- Cyclical esotropia
- Convergence excess esotropia
- Near esotropia

TREATMENT
- Full cycloplegic hypermetropic correction
- Orthoptic treatment to expand base in fusion range
- Delay in initiation of treatment increases the likelihood of not responding to anti-accommodative therapy
- Treat amblyopia
- Gradually decrease hyperopic correction if good control of ensuing esophoria
- Can try Phospholine Iodide drops in cases of poor compliance with glasses. Instruct parents about possible side effects
- Follow up frequently if on Phospholine Iodide

CONTROVERSIES
- Role of surgery
- Indication for miotic drops
- Role of refractive surgery

PARTIALLY ACCOMMODATIVE ESOTROPIA
Definition: A group of esotropias that are helped, but not cured, with glasses for hypermetropia
Alternative Terminology: Partial Accommodative esotropia Constant Esotropia with an accommodative element
Incidence: 10% of Childhood Esotropia
Age: two to five years old
Underlying Cause:
- Hypermetropia
- Poor fusional reserves
- Esophoria
- Not fully understood

PRESENTING SCENARIO
- Esotropia seen when tired or concentrating on close objects.
- Classic Findings:
  - Amblyopia
  - Absent binocular function
  - Suppression of squinting eye
  - If small angle, development of abnormal retinal correspondence (ARC)
  - Hypermetropia
  - Constant esotropia even with “full correction”
  - Family history

DIFFERENTIAL DIAGNOSIS
- Fully accommodative esotropia
- VI nerve palsy
- Congenital esotropia
- Cyclical esotropia
- Convergence excess esotropia

TREATMENT
- Full cycloplegic hypermetropic correction
- Amblyopia treatment (occlusion, atropine, other penalization techniques)
- Prism adaption prior to surgery
- Be conservative about planning surgery
- Rule out latent uncorrected hyperopia before proceeding with surgery
- Do a bilateral medial rectus recession for residual angle of deviation overfull cycloplegic correction
- To plan under-correction
- Explain parents that child needs to wear glasses even after surgery
- Restoration of binocular function rare

ESOTROPIA WITH HIGH AC/A RATIO
Definition: An intermittent esotropia with binocular single vision present at distance fixation
but esotropia on accommodation for near fixation.

**Terminology:** The term convergence excess is sometimes used to include patients with a constant esotropia and no binocular vision.

A near esotropia is a condition with an increased angle for near viewing but not associated with a high AC/A ratio.

The term non-accommodative convergence excess is sometimes used for this condition. Near distance disparity is considered relevant if over 8-10 prism dioptres.

**Incidence:** 27% of esotropia have near distance disparity, but the prevalence of convergence excess is less.

**Age:** Onset is usually between one to four years old, but can be up to aged 10 years.

**Underlying Cause:** High AC/A ratio: not fully understood what underlies this.

**PRESENTING SCENARIO**

Parents see inwardly moving eye when tired or concentrating on near objects. Children occasionally exhibit signs of distress when the eye is squinting. Older children may report double vision at near.

**CLASSIC FINDINGS**

- Good vision each eye
- Amblyopia rare
- Binocular in the distance, reduced at near unless corrected with near add
- May control to a fully accommodative esotropia at distance (with hypermetropic glasses)

Variable control at near
- Esotropia at near, which may be phoric to a non accommodative target
- High AC/A – leading to deterioration of control
- Poor near controlled binocular vision (CBA)

**DIFFERENTIAL DIAGNOSIS**

- Non accommodative esotropia
- Constant esotropia
- Near esotropia
- Hypo accommodative esotropia
- Congenital esotropia

**TREATMENT**

- Full cycloplegic hypermetropic correction when present
- Treat amblyopia if any
- Prescribe executive bifocals bisecting the pupil if distance deviation is less than 15Δ
- Acceptable response is fusion at distance with less than 10 prism diopter of residual esotropia through bifocal at near fixation
- Orthoptic exercises
- Miotics - phopholine iodide
- Surgery

**INDICATIONS FOR SURGERY**

- Reducing binocularity at near
- Reducing control with other forms of treatment (e.g. bifocals)
- Parent/Doctor preference over other treatments (e.g. bifocals)
- Orthoptic exercises not progressing
- Consider prism adaptation to the near angle

**TYPE OF SURGERY**

- Large bilateral medial rectus muscle recession - if distance deviation is more than 15Δ even with glasses
- Pulley surgery
- Slanted recession
- Posterior fixation
- Medial rectus recession with resection

**CONTROVERSIES**

- The terminology
- Use of bifocal glasses
- Indications for surgery
- Surgical Procedure

**NON-ACCOMMODATIVE ESOTROPIA**

**Definition:** An esodeviation occurs after six months of age that is not improved with hypermetropia correction.

**Alternative Terminology:** Acquired non-accommodative esotropia

**Incidence:** 16% of childhood esotropia11, 17.7/100,000 live births
**Age:** two to five years old  
Underlying Cause: Not fully understood

**Presenting Scenario:**  
Esotropia seen when tired or concentrating on close objects.

**Classic Findings:**  
Onset maybe acute  
Family history of strabismus 34%  
Reduced binocular function  
Suppression of squinting eye  
Amblyopia 41%  
Low hypermetropia or emmetropia (Mean of +1.42)  
Esophoria breaking down to esotropia  
Family history

**DIFFERENTIAL DIAGNOSIS**
- Accommodative esotropia
- VI nerve palsy
- Cyclical esotropia
- Other neurological disease

**TREATMENT**
- Trial of full hypermetropic correction
- Amblyopia treatment (occlusion, atropine, other penalization techniques)
- Prism adaption prior to surgery
- Surgery to restore ocular alignment (73%)

**INTERMITTENT DIVERGENT SQUINT**

**Definition:** An intermittent exotropia, with a larger angle at distance.

**Terminology:** Intermittent exotropia, distance exotropia, exotropia of divergence excess type.  
Incidence: Up to one% of all children, or 32 per 100,000 of children under 19.

**Age:** Onset usually between two to four years old  
Underlying Cause: Unknown

**PRESENTING SCENARIO**  
Parents see outwardly moving (or turned) eyes when tired, day-dreaming or in bright sunlight.  
Uniocular eye closing in bright sunlight.-diplophotophobia  
Double vision rare. Usually few if any child reported symptoms.

**DIFFERENTIAL DIAGNOSIS**
- Infantile exotropia (usually constant, onset before six months of age)
- Sensory exotropia (poor unilateral vision)
- Convergence weakness (bigger angle for near)
- Convergence insufficiency (poor convergence)
TREATMENT
• Prescribe corrective lenses for refractive errors
• Myopia and astigmatism should be fully corrected
• Ignore hyperopia of up to +2.00D
• High hyperopia > 4 D needs to be corrected as optical blur may itself increase exotropia
• Over minus lens effective as temporary measure to delay surgery in pre-school age children
• Maintain/treat visual acuity
• Monitor control
• Unilateral or alternating occlusion
• Minus lens therapy
• Exercises
• Surgical correction depending on the angle of the deviation

INDICATIONS FOR SURGERY
• Increase in the angle of deviation with deteriorating control
• Decrease in stereoacuity
• Coexisting convergence insufficiency refractory to orthoptictreatment
• Asthenopia
• Development of amblyopia/suppression
• Surgeon/parent/patient preference
• To improve or maintain binocular single vision

TYPE OF SURGERY
Unilateral recess resect, unilateral or bilateral lateral rectus recession

CONTROVERSIES
The value (if any) of orthoptic exercises/vision therapy
Indications for surgery
Ideal age for surgery
Natural history
Long term prognosis

COMPLICATIONS
Post operative over corrections.
Managed by alternate patching, temporary prisms, botulinum toxin or re-operation

INCOMITANT SQUINT
A squint is termed incomitant when the deviation varies in size with the direction of gaze or with the eye used for fixating

HISTORY
• Age of onset of squint
• Precipitating factors like trauma, febrile illness
• Diplopia – duration, mode of onset, diurnal variation
• Abnormal head posture
• Systemic conditions like DM, IHD, and Thyroid disorder
• Abnormal eye movements Oscillopsia, if nystagmus is present
• Associated neurological symptoms like loss of consciousness, convulsion, motor weakness, slurring of speech, giddiness etc
• Previous surgery for strabismus
• Occlusion therapy and compliance
• Previous spectacle wear
• Any other surgery like R.D, cataract, glaucoma implant, sinus surgery or neuro surgery

BIRTH HISTORY AND MEDICAL HISTORY
• Gestational age
• Significant antenatal history
• Maternal infection, any drugs taken during pregnancy
• History of any other handicap
• Any untoward event during delivery
• Birth trauma, forceps, birth asphyxia
• Birth weight of the child
• History of being kept in incubator and history of oxygenation
• Is the child thriving well?
• Developmental milestones, both physical and mental
• Any associated systemic problem
• Other associated neurological problems like cerebral palsy, epilepsy, mental retardation and craniofacial anomalies
FAMILY HISTORY
- Consanguinity
- Similar problems in other siblings
- History of any inherited eye or systemic condition

EXAMINATION
- Record visual acuity for distance and near
- Do dynamic retinoscopy
- Note any abnormal head posture
- Do cover tests
- Krimsky test or Hirschberg’s test in case of uncooperative patients and those with poor fixation/vision
- Note difference between primary and secondary deviation
- Check versions and ductions
- Note limitation, over action and under action of muscles
- Note any nystagmus – mention type of nystagmus, jerk or pendular, note null point if any

ANTERIOR SEGMENT EXAMINATION BY SLIT-LAMP / TORCH LIGHT
- Note any congenital anomalies like aniridia, coloboma, heterochromia, and cataract.
- Check pupillary reaction

At Squint Clinic
- Review history
- Note any anomalous head posture, position of lids
- Perform cover tests
- Measure angle of deviation, both primary and secondary; in all cardinal positions of gaze
- In adults assess if single binocular vision is achieved in primary position and reading position with prisms
- Recheck ductions and versions
- Check torsion by Maddox rod/double Maddox rod
- Do diplopia charting/Hess charting

- Do Parks three step test in case of vertical strabismus
- Perform forced duction test if indicated
- Detailed fundus evaluation
- Neuroimaging in cases of recent onset paralytic strabismus in the absence of diabetes, hypertension, in cases of trauma, or when multiple cranial neuropathies or suspected space-occupying lesion
- Order thyroid function tests and rule out myasthenia, when aetiology is unclear
- Order cross consultation with neuro-ophthalmologist if indicated

MANAGEMENT
- Correct refractive error by appropriate glasses
- Manage amblyopia if any, by occlusion regimen
- Observation if paralysis is of acute onset
- Botulinum toxin injection into the antagonist muscle in selected cases
- Patch to relieve diplopia
- Prisms to achieve binocular vision in case of small angle deviation
- Do surgery in patients with large angle deviation, after waiting for at least six months after the onset, for recovery and stability
- Surgical plan is based on Hess charting, measured angle of deviation
- Adjustable suture technique is better, as results are unpredictable
BOTULINUM TOXIN INJECTION

It is frozen lyophilized protein drug produced by the bacterium clostridium botulinum. Out of six toxins produced by clostridium botulinum, type A is used clinically.

MECHANISM OF ACTION
Acts by blocking the release of acetylcholine at the neuromuscular junction
Produces temporary, reversible, dose-related paralysis, of the muscle
It is bound and internalized in 24 to 48 hours within local motor nerve terminals, where it remains for many weeks.
The injected extra ocular muscle lengthens and its antagonist contracts

ONSET OF ACTION
• Tow to four days

DURATION OF ACTION
• Extra ocular muscles – five to eight weeks
• Orbicularis muscle – 12 to 15 weeks

INDICATIONS AND CLINICAL USES
Strabismus
• Best results are achieved when fusion is present to stabilize the alignment
• Small to moderate angle esotropia or exotropia (<40 PD)
• Postoperative residual strabismus (2-8 weeks after surgery)
• To eliminate diplopia in acute paralytic strabismus (commonly sixth nerve)
• Cyclic esotropia
• Active thyroid eye disease (when surgery is inappropriate)
• Supplement to MR recession in large angle infantile esotropia
• Botulinum injection is ineffective in large deviations, restrictive strabismus (trauma, chronic TED), A and V patterns, DVD, oblique muscle disorders, and chronic paralytic strabismus

Blepharospasm
• Very effective in the treatment of essential Blepharospasm
• Repeated injections are required every two to three months
• Hemifacial spasm
• Nystagmus
• Induce ptosis in patients with corneal disease

INJECTION PROCEDURE
• Commercial preparations are Oculinum, Dysport, and Botox
• Reconstitution 2.5 units per 0.1 ml
• Take consent
• Explain procedure
• Injection is made directly into the selected extra ocular muscle or the orbicularis
• In adults, injection is performed using a portable electromyography device; children require GA
• It can be injected subcutaneously at sites depending on muscles that need to be paralyzed
• Rule out secondary causes of blepharospasm such as dry eyes and foreign body
• Essential blepharospasm needs no neuroimaging prior to injection, whereas
• Hemifacial spasm needs neuroimaging prior to injection

COMPLICATIONS
Common
• Ptosis, incomplete eyelid closure, dry eye, and induced vertical strabismus

Rare
• Scleral perforation, retrobulbar hemorrhage, pupillary dilatation, and permanent diplopia
ALLERGIC CONJUNCTIVITIES

Types
- Seasonal allergic conjunctivitis
- Vernal conjunctivitis
- Atopic conjunctivitis
- Giant papillary conjunctivitis (GPC)

ASSOCIATED / PREDISPOSING FACTORS
Seasonal : Environmental allergens
Vernal : Hot dry environments
Atopy : Genetic predisposition
GPC : Soft contact lens
- Prolonged wear of contact lens
- Protruding sutures
- Prosthesis

NATURAL HISTORY
Seasonal
- Recurrent

Vernal
- Childhood onset
- Chronic course
- Exacerbates in spring
- Reduces in activity as the child grows older

Atopic
- Childhood onset
- Chronic course
- Acute exacerbation

GPC
- Gradual increase in symptoms with contact lens wear
- Exposed corneal / scleral sutures

COURSE OF DISEASE
Seasonal
- Minimal sequelae

Vernal
- Eyelid thickening
- Corneal ulcer
- Corneal vascularization
- Keratoconus
- Visual loss

GPC
- Ptosis

SYMPTOMS AND SIGNS OF CONJUNCTIVITIS
Seasonal
- Symptom
- Watery discharge

Signs
- Bilateral
- Chemosis
- Conjunctival injection

Vernal
- Symptom
- Severe itching
- Mucoid discharge

Signs
- Bilateral
- Papillary hypertrophy of superior tarsal conjunctiva
- Limbal trantas spots
- Limbal papillae
- Corneal epithelial erosions
- Corneal neovascularization and scarring
- Corneal vernal plaque
- Shield ulcer
Atopic

- Symptom
- Itching
- Mucoid discharge

Signs

- Bilateral
- Papillary hypertrophy of superior and inferior tarsal conjunctiva
- Eczemoid blepharities
- Eyelid scaring
- Periorbital darkening
- Loss of eye lashes
- Punctate epithelial erosions
- Corneal neovascularization and scarring
- Keratoconus
- Subcapsular cataract
- Pseudogerontoxon

Silent lamp photos of VKC with shield ulcer, giant papillae, perilimbal pigmentation and pseudogerontoxon

TREATMENT

General Treatment

- Do not rub the eyes because rubbing can cause mechanical mast cell degranulation and worsening of symptoms
- Cool compresses can help reduce eyelid and periorbital edema
- Frequent use of refrigerated artificial tears
- Avoidance or reduction of contact with known allergens

Seasonal Allergic Conjunctivitis

Mild

- Antihistamines/ Vasoconstrictors/topical histamine receptor antagonist
- Recurrent/Persistent: Mast cell stabilizer/combination (mast cell stabilizer + antihistamines)
- Additional measures
- Artificial tears
- Cool compresses
- Oral antihistamines
- Allergen avoidance

Vernal Conjunctivitis

- General treatment
- Cool compresses
- Ocular lubricants
- Topical and oral antihistamines
- Topical mast cell stabilizers
- Eg: Cromolyn sodium (not useful in acute symptoms)
- Topical antihistamines and mast-cell stabilizers (preferred)
- Eg: olopatadine
- Topical corticosteroids
- Used only in refractory cases/severe + active cases
- Used as pulse therapy for two weeks
- Baseline and periodic measurement of IOP and pupillary dilation should be performed to evaluate for cataract and glaucoma

GPC

- Symptom
- Mucoid discharge

Signs

- Papillary hypertrophy of superior tarsal conjunctiva
- Severe cases ptosis
- Soft steroids like loteprednol and fluromethalone can be used two to four times/day/2 weeks
- Topical cyclosporine two%
- Useful in refractory cases and in whom topical steroids can’t be used/compliation to steroid

**Atopic Kera to conjunctivitis**

In addition to the above treatment modalities:
- Tacrolimus ointment 0.03% is used for children 2 years to 15 years old; either 0.03% or 0.1% is used for patients 16 years and older
- Systemic antihistamines
- Dermatologist reference

**Giant Papillary Conjunctivitis**

- Removal of the causative entity like protruding knots
- If contact lens induced mild GPC replacing lenses more frequently, decreasing contact lens wearing time, increasing the frequency of enzyme treatment, using preservative-free lens care systems, change over to daily disposable
- Severe GPC - avoid contact lens for two weeks, topical steroids

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**PEDIATRIC CORNEAL OPACITIES**

**CAUSES**

**COMMON**
- Post traumatic scar
- Corneal ulcer scarring
- Peter’s anomaly (anterior segment dysgenesis)
- Descemet’s tear (Birth trauma)

**RARE**
- Xerosis (Vitamin A deficiency)
- Sclerocornea
- Limbal dermoids
- Corneal dystrophy
- Metabolic disorders

**WORK UP**

**HISTORY**
- Establish the etiology
- Associated redness, purulent discharge
- Malnutrition, diarrhoea, measles
- Systemic anomalies
- Consanguinity
- Birth history
- Birth trauma
- Family history of ocular ailment
- Previous surgical or medical treatment

**VISUAL SYMPTOMS**
- Uniocular vs binocular
- Strabismus
- Nystagmus

**EXAMINATION**

**VISUAL ACUITY**
- Dilated and undilated with Snellens if possible or with Lea or Cardiff or Lea paddles
- Fixation preference, if any with CSM grading
• Retinoscopy undilated and cycloplegic
• Look for glow in undilated Vs dilated examination
• Any abnormal corneal reflex/scissoring
• Keratometry, baseline for further evaluation
• Vision with trial Contact lens
• Strabismus or Nystagmus

ANTERIOR SEGMENT EXAMINATION
• Microcornea
• Size of opacity
• Location - pupillary, paraxial, limbal
• Grading - Nebular, macular, leucomatous
• Stromal extent
• Endothelial status
• Limbal stem cell assessment
• Associated corneal edema
• Anterior chamber - activity, dysgenesis
• Iris - Polycoria, abnormal pattern
• Pupil - Reaction to light, corectopia
• Lens - Cataractous
• IOP
• Gonioscopy if possible
• Pachymetry

FUNDUS EXAMINATION
• Media clarity
• Any posterior segment pathology
• EUA if required for complete ophthalmic evaluation and CL trial can be planned.

REFERRAL
• To pediatric if suspecting inborn errors of metabolism or Vitamin A deficiency

INVESTIGATIONS
• Corneal topography
• Anterior segment OCT/UBM
• B - scan if no fundus view

MANAGEMENT
• Opacities are irreversible
• Treatment of systemic/ocular disease if any

VISUAL REHABILITATION
Causes of Decrease in Vision:
• Refractive error - Regular or irregular astigmatisms
• Visual axis obscuration
• Associated eye conditions, e.g. Glaucoma,
• Amblyopia - refractive or stimulus deprivation

REFRACTIVE CORRECTION
• Glasses or Contact - Lenses
• Contact-Lenses indicated in irregular anterior corneal surface

TREATMENT OF ASSOCIATED EYE CONDITIONS
• Glaucoma can be managed medically or surgically
• Limbal stem cell deficiency if suspected, may improve with Amniotic membrane grafting or Limbal stem cell transplant

VISUAL AXIS OBSCURATION
• Small central corneal opacity
• Trial of dilating drops
• Tropicamide 1%, 3 times a day in waking hours at 5 hours interval with last application 5 hours before sleeping
• Needs close follow up of child and good compliance from parents and teacher

LARGE CENTRAL OPACITY
• Broad optical PI in the quadrant over clear cornea

KERATOPLASTY
• Lamellar keratoplasty may help in epithelial dystrophy
• Penetrating keratoplasty is usually required.

LIMITATION
• Age matched donors
• Corneal curvature changes in infants give rise to refractive surprises
• Amblyopia restricts visual restoration
• Long term complications like glaucoma, cataract and retinal detachment

AMBLYOPIA THERAPY
• Appropriate correction of refractive error
• Visual axis clearance
• Part time occlusion of preferred eye

PEDIATRIC CATARACT

OVERVIEW
Diagnosis, evaluation, surgical procedure and post-operative care in pediatric cataract is significantly different compared to that of a typical adult cataract patient.

Cataract removal is only the first step in a long process. Importance of refraction, amblyopia therapy and need for follow up cannot be underplayed.

A close follow up is required following surgery to monitor visual axis to prevent amblyopia, to give appropriate refractive correction and to detect asymptomatic complications like glaucoma.

It is estimated that one in 250 children have some type of cataract.

CLASSIFICATION

According to age of onset
• Congenital (at birth)
• Infantile (first year of life)
• Developmental (two to 10 years)

According to morphology

Types of congenital cataracts: Posterior polar, Blue dot, Zonular cataract and Sutural cataract
• Blue dot cataract
• Anterior polar cataract
• Anterior subcapsular cataract
• Lamellar cataract
- Zonular / Nuclear
- Posterior subcapsular
- Posterior lenticus
- Total cataract
- Persistent fetal vasculature

**AETIOLOGY**
- Idiopathic – Most common (60%), Mostly bilateral
- Hereditary - (30%) Mostly autosomal dominant, bilateral
- Usually no ocular or systemic association

**Antenatal Infections**
- TORCH
- Rubella most common in India
- First trimester of pregnancy

**Metabolic**
- Galactosemia
- Homocystinuria (mostly ectopia lentis)

**Trauma**
- Traumatic cataracts are common in pediatric age group with both penetrating as well as blunt injury
- Steroid induced cataracts are also common especially after injudicious use of topical steroids for allergic conjunctivitis

**ASSOCIATIONS**

**Ophthalmic**
- Microcornea (Most common association)
- Microphthalmos
- Persistent fetal vasculature
  - Persistent pupillary membrane
  - Stretching of the ciliary processes
  - Iridohyaloid blood vessels
  - Persistence of the posterior fibrovascular sheath of the lens
  - Persistent hyaloid artery
  - Tent-shaped retinal detachment
  - Aniridia
  - Peter's anomaly

**SYSTEMIC ASSOCIATIONS**
- Lowe syndrome (oculo-cerebral-renal syndrome)
  - X-linked recessive
  - Renal tubular dysfunction
  - Hyperparathyroidism
  - Hypophosphatemia
- Down syndrome (Trisomy 21)
  - Blue dot cataract most common
- Galactosemia:
  - Liver dysfunction
  - Renal tubular dysfunction
- Homocystinuria
  - Osteoporosis
  - Mental retardation in 50%
  - Thromboembolism
- Marfan syndrome
  - Cardio-vascular disorder
  - Aortic root dilation- most common
- Congenital rubella syndrome
  - Patent ductus arteriosus
  - Sensory-neural hearing deficit

**HISTORY**
- When was white reflex noted?
- Unilateral/Bilateral
- Abnormal eye movements
- Squint
- Visual behaviour

**FAMILY HISTORY**
- H/o childhood cataract in parents/ siblings
- H/o metabolic or systemic disorder in siblings/parents
- H/o consanguinity

**ANTE-NATAL HISTORY**
- H/o any infection
- H/o rash/fever especially in first trimester

**BIRTH HISTORY**
- Gestational age
- Birth weight
- Type of delivery
Perinatal history

DEVELOPMENTAL HISTORY
- Trauma
- Redness, pain
- H/o chronic steroid use
- Topical/Systemic medication
- H/o vaccination

EXAMINATION
GENERAL EXAMINATION
- General condition
- Weight
- Motor milestones
- Notable systemic features

VISUAL FUNCTION
- Fixation with light/objects. Look for CSM
- Fixation preference
- Resistance to occlusion
- Visual acuity function with age matched cards can be tried in preverbal/older children like Teller acuity charts, Cardiff charts, Lea symbols, Snellen's

SQUINT EVALUATION
- For distance and near
- Look for the preferred eye
- Presence of strabismus with fixation preference indicates unequal vision as well as longstanding nature of the visual deprivation
- Look for Nystagmus which is indicative that cataract is visually significant and requires surgical intervention. Subtle nystagmus is often best seen on slit lamp

OCULAR ADNEXA
- Rule out naso-lacrimal duct obstruction by pressing over sac area and noting regurgitation of discharge if any

REFRACTION
- Dry retinoscopy
- Look for glow on distant direct ophthalmoscopy, helpful in cases of asymmetrical cataracts as well as small opacities
- Cycloplegic refraction

SLIT LAMP EXAMINATION (UNDILATED AND DILATED)
- Co-operation can be an issue in younger children
- Be ready with a plan, whatever is most important should be examined first
- Try examining the child as far as possible without touching
- Conjunctiva: Congestion, ciliary injection if any
- Cornea: Size, Opacity
- AC depth
- Pupillary reaction
- Lens: Size of cataract, is it obscuring visual axis, is it dense enough to cause vision deprivation, whether it is symmetrical in both eyes
- Morphology of cataract: Zonular or posterior capsular or lenticular as this gives a clue to the visual prognosis
- Phacodonesis or subluxation if any
- Anterior capsular status, presence of lens matter / blood in AC in case of trauma
- Posterior capsular dehiscence, often coexists with lenticular
- Coexisting anterior segment anomalies like iris coloboma, lens coloboma, aniridia
- Look for evidence of previous episodes of inflammation in form of KPs or posterior synechiae
- Intraocular pressure if co-operative
- Gonioscopy
- Fundus examination if possible. Surprisingly, in
several cases despite dense central cataracts periphery is relatively clear allowing a good fundus view

- Examination of parents and siblings can also give important clues to etiology

**ANCILLARY TEST**

- Ultrasonography if there is no fundus view. Look for attached retina, any PFV. In cases of trauma, usg is invaluable to rule out IOFB, vitritis or Vitreous hemorrhage etc.
- UBM- Few indications, may be helpful in certain cases to assess zonular status

**FACTORS INFLUENCING TIMING OF SURGERY**

**Laterality:** Unilateral or bilateral asymmetrical cataracts will need early intervention. The eye with denser cataract needs to be operated first. Bilateral symmetrical cataracts are less amblyogenic than unilateral cataracts.

**Morphology:** Posterior cataracts are more vision threatening compared to nuclear or anterior cataract and need early intervention.

**Size of Cataract:** Small cataracts not obscuring visual axis can be left alone, for instance, blue dot cataract.

If lenticular opacity is less than three mm of size and in visual axis, a trial of dilating drops (tropicamide) can be given. However, these children need a close watch.

We prescribe tropicamide one% at five hourly intervals in waking hours. Cataract more than three mm in size involving visual axis needs surgical intervention. Presence of strabismus or nystagmus are indications for early intervention.

**ANTERIOR CAPSULAR RUPTURE/INTUMESCENT LENS**

- Early surgery is required to prevent inflammation or pressure spike
- In symmetrical bilateral cataracts we plan other eye surgery after one week
- Time of surgery

**Congenital Cataract:** four to six weeks of age depending on fitness from point of view of general anesthesia

**Counseling the Parents:** Parents are your best partners in care and they should be equally involved in the decision making. Parental counseling should stress on:

- Most probable etiology (Why it happened?)
- Need for investigations
- Pros and cons of surgical plan specially involving IOL
- Rehabilitation after surgery, stressing the need for spectacles, amblyopia therapy, and the need for lifelong follow up
- Long term complications like glaucoma and retinal detachment
- Last but not the least, genetic counseling and screening of siblings

**MANAGEMENT**

**SURGICAL MANAGEMENT**

**Pre-operative**

**Lab investigations**

1) To establish the etiology
   - TORCH titre
   - Urine to screen for inborn errors of metabolism

- Unilateral cataracts are most often secondary to an isolated ocular abnormality or idiopathic and thus do not require extensive work up

2) Review by a pediatric to rule out systemic associations and for fitness for anesthesia

**ANESTHESIA**

- General anesthesia

**IOL POWER CALCULATION**

- Pre-operatively if co-operative can be done under GA if required
- Formula used: SRK II formula for most children
  - Hoffer Q if AL less than 20mm
  - SRK/T if AL > 24 mm
SELECTION OF IOL POWER FOR CHILDREN

- One way to undercorrect is to follow the “Rule Of Seven” i.e Seven minus age of the pt in years is the amount of undercorrection required for that age. For instance a three year old is kept 4 D undercorrected (7-3 =4)
- Undercorrection to leave the children with hyperopia is the preferred strategy
- Undercorrection is based on age
- Under one year of age +5 D to +6 D hyperopia
- One to three years +3D to +4D of hyperopia
- Four to six years +2D to +3 D of hyperopia
- Seven to 10 years +1.5D to +2D of hyperopia
- 10 -12 years +1 D of hyperopia
- 13 years and above +0.5D or can choose emetropic power
- Please remember that these are general guidelines and you may have to customize

The common factors like age associated axial length, corneal curvature (deviation from normalcy), laterality, mental status commonly influence the decision on IOL power to be implanted

- In unilateral cataracts, it may be wise to match it with the refractive error of the other eye so as to not induce anisometropia inadvertently
- For traumatic cataracts or in cases where lens is sulcus fixated we undercorrect the power further by +1.0 D

In general, as far as our experience goes, it is very difficult to predict emmetropisation in a given child. Hence, we prefer a little less undercorrection and the actual IOL power implantation after the age of 10 which definitely reduces the amount of post operative refractive error and increases the visual outcome

SURGICAL MANAGEMENT

PLAN OF SURGERY

- <6 months of age or corneal diameter < 9.5 mm or axial length < 18 mm
- Lens aspiration with posterior capsulotomy with anterior vitrectomy
- 6 months to one year of age with corneal diameter >10.5 with no anterior segment dysgenesis with axial length of at least 18 mm
- Lens aspiration with posterior capsulorrhexis and anterior vitrectomy with an intraocular lens can be planned. Only one rider Intraocular lens must be placed in the bag and not in the sulcus
- One year - eight years of age – Lens aspiration with posterior capsulotomy with anterior vitrectomy with IOL unless IOL is contraindicated
- Eight years and above – lens aspiration with IOL with / without posterior capsulotomy
- Corneal diameter < 6 mm - lensectomy using pars plana approach

POST OPERATIVE MANAGEMENT

- Intense topical steroids to be started on hourly basis initially with gradual tapering over six weeks
- Topical antibiotics (moxifloxacin) for two weeks
• Cycloplegic drops three times a day for two to three weeks
• Manage inflammation with aggressive topical steroid and cycloplegic; rarely systemic steroids may be required as a short course

VISUAL REHABILITATION

APHAKIA
• Bilateral – With glasses or contact lenses corrected for near vision
  Unilateral – With Contact lens

PSEUDOPHAKIA
• <2 years monofocal for near vision
• >2 years bifocals
• Contact Lenses:
  • Silsoft lenses – Silicon hydrogel lenses
  • Available at 1D difference till +20D then every 3D difference till 32D
  • Customized RGP lens
  • Amblyopia therapy based on age should be initiated along with correction in early postoperative period

POST-OP FOLLOW UP
• At six weeks
  • Check vision, fixation preference, refraction, IOP
  • Fundus evaluation
  • Reinforce need for patching and glasses

FURTHER FOLLOW UP
• At three to four months till two years of age, then six monthly till six years of age
• At each visit look for change in refraction, visual axis clarity, IOP measurement and detailed fundus evaluation including special attention on disc

EUA
• If child is uncooperative for exam, EUA should be planned at least once a year. EUA should include detailed examination, pachymetry, axial length measurement, gonioscopy and fundus evaluation

TIME OF SECONDARY IOL IMPLANTATION
• If corneal diameter is at least 10.5 mm and axial length at least 18 mm and adequate capsular support for PC IOL is present, secondary IOL can be planned at around two years of age, ideally before starting school
• If capsular support is inadequate, iris fixated lens or a scleral fixated lens (SFIOL) can be planned after 6 years of age
MARFAN’S SYNDROME
• Autosomal dominant
• Multi systemic involvement
• Full blown presentation by teenage

OCULAR FEATURES
• Subluxation of the lens usually upwards and temporal, symmetrical
• Subluxation increases gradually
• Localized opacification of lens
• May be microspherophakic
• Accommodation is usually normal
• Retinoscopy: Compound myopic astigmatism or axial myopia
• Fundus: myopic fundus changes
• Developmental glaucoma

NON-OCULAR FEATURES
• Cardio-vascular: dilatation of aortic root, Aortic aneurysm
• Tall and thin stature
• High arched palet
• Scolio kyphosis.
• Spina-bifida
• No developmental delay

HOMOCYSTINURIA
• Ocular features are similar to that of Marfan’s syndrome
• Autosomal recessive
• Subluxation of lens inferiorly and nasally, tendency to fully dislocate
• Mental retardation may present
• Thrombo-embolic episodes are common
• Cerebrovascular accidents, myocardial infarction in early adulthood
• Cyanide sodium nitroprusside test is a good screening test
• Condition can be helped by restricting dietary methionine and supplementation of oral cystine and by high doses of vitamin B6 (Pyridoxine)
WEILL MARCHESANI SYNDROME
- Autosomal dominant or recessive Components
- Microspherophakia
- Anterior dislocation most common
- Lenticular myopia
- Pupillary block glaucoma is most troublesome complication
- The patients have a short stubby stature
- Brachycephly
- Cardiac anomalies

WORK UP OF A CASE OF SUBLUXATED LENS

HISTORY
- Vision
- Squint
- Family history
- Trauma,(Unilateral)
- Developmental history
- Medical history
- Associated systemic features

CLINICAL EXAMINATION
- Refraction
- Through phakic and aphakic part
- Strabismus, preference for any particular eye

SLIT LAMP EXAMINATION
- Both dilated and undilated to assess whether pupillary area is mostly phakic or aphakic
- Direction of subluxation
- Clarity of lens
- Irregularly depth of AC
- Phacodonesis, iridodonesis
- Zonules are visible, stretched or broken
- Other associated ocular anomalies
- Look for signs or sequelae of trauma

FUNDUS EXAMINATION
- Myopic macular degeneration
- Peripheral retinal degeneration, breaks, lattices
- Physician/pediatric review to rule out systemic manifestations and appropriate treatment for same

INVESTIGATIONS
- Screening for inborn errors of metabolism
- Urine HPLC test for homocystinuria
- Echocardiogram to evaluate cardiac status
- Ultrasound biomicroscopy to evaluate zonular status to help in surgical plan

CAUSE OF DECREASE OF VISION
- Refractive error
- Amblyopia
- Glaucoma
- Retinal detachment

MANAGEMENT
- Genetic counseling
- Frequent follow ups as condition is progressive in most instances.
- Sibling examinations

OPTICAL CORRECTION
- Best possible refractive correction phakic or aphakic by glasses/contact lens
- Bifocals if prescribing glasses for aphakic portion.
- Treatment of amblyopia by patching
- It is necessary to recheck vision with new glasses for both distance and near

SURGICAL MANAGEMENT

INDICATION
- Anterior dislocation is an emergency as there is risk of acute rise in IOP and corneal decompensation
- Posteriorly dislocated lens may need removal
- Cataractous lens in visual axis causing a drop
in vision

- Pupil bisecting subluxation leading to difficulty in using refractive prescription
- Myopic astigmatism refractory to both glasses and contact lenses
- Asymmetric optical correction
- Occasionally along with posterior segment surgery for treatment of RD, etc

SURGICAL OPTIONS

- Lensectomy with or without scleral fixated intraocular lens in cases where there is significant zonular loss. Scleral fixation of intraocular lens is deferred in children below six years of age
- Phacoemulsification with intraocular lens implantation with capsular tension rings in case of localized zonular damage, mostly in acquired cases
- Peripheral iridotomy in cases prone for pupillar block
- Pars plana vitrectomy and lensectomy if dislocated lens

OPTIONS OF INTRAOCULAR LENS

- SFIOL with thorough core vitrectomy is preferable
- Iris claw lens
- Posteriorly fixated iris claw lens

CONGENITAL DISC ANOMALIES

PRESENTATION

- Visual acuity ranges from total blindness to minimal dysfunction
  - Strabismus
  - Nystagmus

HISTORY

- What is the duration of diminution of vision?
- Is the diminution of vision slowly progressive?
- Is there any nystagmus or strabismus?
- Is there any history of consanguinity amongst parents?
- Is there any family member affected?
- Is there any mental retardation/developmental delay?
- Are there any other systemic abnormalities?

EXAMINATION

- Best corrected visual acuity
- Slit lamp examination
- Lens changes
- IOP
- Fundus
- Indirect ophthalmoscopy with 20 D and 78D

Disc: Size (Hypoplasia, megalopapilla)
  - Shape: (Tilted disc, pit, coloboma)
  - Margins: (Drusen)
  - Color: Pallor (Autosomal dominant optic atrophy)

Arteries: Attenuation, abnormal orientation (Morning glory syndrome)

Macula: Dragged, distance from disc to macula, sub retinal fluid.

Fundus photo showing optic disc coloboma
INVESTIGATIONS

- Color vision
- Visual fields
- Fundus photo
- Neuro imaging
- ERG
- VEP

TREATMENT

- Glass prescription
- Low vision aids
- Systemic examinations
- Genetic counseling
- Advice ocular examination of other family members
- Do not give a very poor prognosis to the patients, emphasize on the positive side- the patient is very unlikely to be completely blind
- Routine monitoring every year or as and when required to treat the complications associated with the disease
- Rehabilitation
- Information about new scientific developments

OPTIC NERVE HEAD DRUSEN

- Rare, mostly bilateral
- Calcium deposits within the optic nerve head not evident at birth but more visible around first decade
- Can be superficial or deeply buried

INVESTIGATIONS

- A and B scan ultrasonography: disc elevation with high reflective spike
- CT scan
- Visual fields – enlarged blind spot
- Autofluorescence
- Ocular complications:
  - Asymptomatic visual loss or transient vision loss
  - Ischemic optic neuropathy
  - Peripapillary serous chorioretinopathy
  - Venous occlusions

HYPOPLASTIC DISC

- Most common optic disc anomalies
- Subnormal number of optic nerve axons with normal mesodermal elements and gial tissue
- Unilateral or bilateral

CLINICAL PRESENTATION

- VA - Variable according to severity (6/6 to NPL)
- Small disc surrounded by halo (double ring sign)
- Disc to macula ratio 2.62 as opposed to 2.94 in normal
- Vessel normal caliber but may be tortuous
- Occasional Association: Disorders involving mid line structures of brain
- De Morsier syndrome (septo-optic dysplasia)
- Absence of septum pellucidum and corpus callosum
- Triad of short stature, nystagmus and

<table>
<thead>
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<th>Disc Anomalies</th>
<th>Systemic Associations</th>
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<tbody>
<tr>
<td>Optic disc hypoplasia</td>
<td>De Morsier syndrome (septo-optic dysplasia)</td>
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<tr>
<td>Optic disc dysplasia</td>
<td>Transphenoidal form of basal encephalocele</td>
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<tr>
<td>Morning glory disc</td>
<td>Basal encephalocele</td>
</tr>
<tr>
<td>Disc coloboma</td>
<td>Papillorenal (renal-coloboma) syndrome Patau syndrome (trisomy 13) and cat-eye syndrome (trisomy 22) ‘CHARGE’</td>
</tr>
<tr>
<td>Tilted disc</td>
<td>Situs inversus</td>
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</table>
hypo plastic disc
• Maternal diabetes
Other ocular associations: defective Color vision, relative afferent pupillary defect, foveal hypoplasia, aniridia, microphthalmos

DYSPLASTIC DISC
• Strikingly deformed disc with anomalous retinal vasculature
• Associated with morning glory disc anomaly with transphenoidal form of basal encephalocele
• Associated with infrapapillary tongue shaped retinochoroidal depigmentation
• Investigations: Neuroimaging to look for transphenoidal encephalocele

MORNING GLORY DISC:
• Very rare, usually unilateral, more common in females

CLINICAL FEATURES
• Visual acuity – Vary from NPL to 6/6
• Large disc with funnel-shaped excavation
• Glial tissue within base
• Spoke-like emerging vessels, more in number
• Surrounding chorioretinal pigmentary disturbance
• Complications: Serous retinal detachment in about 30%
• Occasional Association: Basal encephalocele which is frequently associated with mid-facial anomalies

MYELINATED NERVE FIBRES
• Myeliation begins at fifth month of gestation and progresses to reach lamina cribrosa by birth
• If it extends intraocularly anteriorly over the surface of the disc and retina, is called as myelinated nerve fibres
• Usually unilateral
• Visual acuity – 6/6 to 6/60 depends on the macular involvement

TYPES
• Isolated
  – Peripapillary
  – Extensive

Investigations: Visual fields; enlarge blind spot

DISC COLOBOMA
• Rare, unilateral or bilateral
• Usually sporadic - occasionally dominant
• Incomplete or abnormal coaptation of proximal end of embryonic fissure
• Visual Acuity – depends on involvement of papillomacular bundle
  Amblyopia treatment helps to improve visual acuity
Ocular Associations: May be associated with other colobomas (choroid, retina, iris, ciliary), microphthalmia, orbital cyst, retinal detachment
• Occasional Systemic Associations of Optic Disc Coloboma:
  1. CNS Malformation - Basal encephalocele and cysts
  2. Chromosomal Anomalies - Patau syndrome (trisomy 13) and cat-eye syndrome (trisomy 22)
  3. ‘CHARGE’ - Coloboma, heart defects, choanal atresia, aetarded development, genital and ear anomalies
  4. Other Syndromes - Meckel-Gruber, Goltz, Lenz microphthalmos, Walker-Warburg and Goldenhar

INVESTIGATIONS
B scan optic disc Coloboma: Cup shaped defect in the optic disc Low reflectivity echo

OPTIC DISC PIT
• It is a congenital excavation of the optic nerve head that may be associated with other abnormalities of the optic nerve and peripapillary retina
• Incidence: One in 10,000 people, with no gender predilection, and are usually sporadic
**CLINICAL FINDINGS**

- Asymptomatic
- Visual acuity: 6/6 to 6/60
- Disc pit may lead to serous detachments of the retina, with associated full-thickness or laminar retinal holes, retinal pigment epithelium mottling and general cystic changes.

**INVESTIGATIONS**

- OCT: shows a schisis like separation between the inner and outer retina and a larger retinal detachment
- Visual fields: Arcuate scotoma, enlarged blind spot
- FFA: No dye accumulation in the area of the serous detachment

**MANAGEMENT**

- Laser photocoagulation: Burns between optic Disc and serous retinal detachment
- Macular buckling
- Vitrectomy

**TILTED DISC**

- Tilted disc syndrome, or Fuchs Coloboma, the superior pole of the optic disc appear elevated with posterior displacement of the inferior nasal disc
- It has an obliquely oriented long axis

**ASSOCIATED FEATURES**

- Myopia
- Scleral crescent located inferiorly or inferonasally
- Situs inversus (a nasal detour of the temporal retinal vessels as they emerge from the disc before turning back temporally)
- Posterior ectasia of the inferior nasal fundus

**INVESTIGATIONS**

Visual fields: Bitemporal hemianopia, which is typically incomplete and preferentially involves the superior quadrants and does not respect the vertical midline
Tilted discs, myopic astigmatism, bilateral decreased vision, and visual difficulty at night should suggest the possibility of X-linked congenital stationary night blindness

**MISCELLANEOUS OPTIC DISC ANOMALIES**

- Peripapillary staphyloma
- Megalopapilla
- Optic nerve aplasia

<table>
<thead>
<tr>
<th>Morning glory syndrome</th>
<th>Disc coloboma</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>No gender predisposition</td>
</tr>
<tr>
<td>Unilateral</td>
<td>Bilateral</td>
</tr>
<tr>
<td>Disc lies within the excavation</td>
<td>Excavation lies within the optic disc</td>
</tr>
<tr>
<td>Central glial tuft</td>
<td>No glial tuft</td>
</tr>
<tr>
<td>Abnormal retinal vasculature</td>
<td>Normal retina vasculature</td>
</tr>
<tr>
<td>Basal encephalocele is common</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Rarely associated with genetic disorders</td>
<td>Associated with multisystem genetic disorder</td>
</tr>
</tbody>
</table>
**RETINOPATHY OF PREMATURITY**

**MINIMAL RELEVANT HISTORY TO BE RECORDED**

**GESTATION AGE (WEEKS AT DELIVERY)**
- Chronological age (weeks after birth)
- Birth weight
- Reason for NICU admission
- Whether any supplemental oxygen therapy given (ventilator support)
- Type, duration of oxygen therapy
- H/o seizure disorder
- H/o blood transfusions
- H/o neonatal septicemia
- H/o concurrent illnesses
- H/o multiple births
- Previous treatment if any

**EXAMINATION**

Dilated fundus examination with Indirect ophthalmoscopy with scleral depression three to four weeks after birth or before discharge from the neonatal unit whichever is earlier.

Dilate with combination of phenylephrine 2.5% and tropicamide 1% instilled twice at 10 minutes interval with simultaneous punctual occlusion.

In lieu of ideal combination of phenylephrine 10% and tropicamide 1% as mentioned above, one can mix 1cc of 10% phenylephrine with 3cc of 1% tropicamide (both commonly available). This gives a combination of phenylephrine 2.5% and tropicamide 0.75%.

- Instill a drop of paracaine (topical anaesthetic)
- Use Alfonso or other infant speculum for exposure
- Scleral indentation is done with a Wire vectis
  A condensing lens of 20 D is used for comparison with standard photograph. 28D/ 30 D lens may also be used.

Data Recording

Use ROP data sheet (Refer Annexure 1)

Examine the cornea and anterior chamber

Mention extent of pupillary dilation, presence of iris vascular engorgement, persistent pupillary membrane, vitreous haze or hemorrhage

Record location of ROP-zone 1, zone 2 or zone 3

Enter number of clock hours involved.

Note severity of the disease by stages 1 through 5.

Look for signs of Posterior Plus disease (sufficient vascular dilatation and tortuosity present in at least 2 quadrants of the eye), A + symbol is added to the ROP stage number to designate the presence of plus disease. For example - stage 2 ROP combined with posterior vascular dilatation and tortuosity should be written “stage 2 +ROP.”

Look for signs of Pre-Plus disease and can be noted beside the stage, for example – “stage 2 with pre-plus disease”.

Look for signs of Aggressive posterior retinopathy (AP-ROP)

Notice previous treatment marks– cryo or laser scars, if any.

Watch for Apnoeic spells (crying is a good sign)

Dragging of optic disc as a sequaelae of retinopathy of prematurity

**TREATMENT**

If normal retinal vascularization is seen 360 degrees up to ora serrata, only follow-up examination is needed perhaps at six months.

1. Plus disease is defined as a degree of dilation and tortuosity of the posterior retinal blood vessels as defined by a standard photograph.

2. Pre-Plus disease is defined as abnormal dilatation and tortuosity of the posterior pole vessels that are insufficient for the diagnosis of plus disease but that demonstrate more arterial tortuosity and more venous dilatation than normal.

3. AP-ROP Posterior pole is defined as vascular dilation and tortuosity of all 4 quadrants that is out of proportion to the peripheral retinopathy most commonly in zone I causing inability to differentiate arterioles and venules.
It is assumed that 360° examination could be performed adequately and normal vascularization was noted up to ora serrata. In case of any doubt a review after one week is advised.

If retinal vasculature is immature and extends into zone II but no retinopathy is present, follow-up examination should be planned at two weeks. Either normalization takes place or ROP develops.

If retinal vasculature is immature and extends into zone I but no retinopathy is present and there is no plus disease, weekly examination is mandatory. Sometimes it can develop into Aggressive posterior ROP (AP-ROP) which does not necessarily follow classical 1-3 staging.

Stage 1 or 2 ROP in zone II/III with no Plus disease, follow-up examination should be planned at 1 to 2 weeks.

Stage 1 or 2 ROP in zone I or Stage 3 ROP in zone II, with no Plus disease, follow-up examination should be planned at ≤1 week.

Refer flow chart 1 & 2 for complete planning.

Type 2 ROP needs to be watched and treatment should be considered only if they progress to type 1 ROP or threshold ROP.

Type 1 ROP is defined as Zone 1, any stage with plus disease, or zone 1, stage 3 without plus disease or Zone 2, stage 2 or 3 with plus disease (type 1 includes eyes with threshold ROP).

Type 2 ROP is defined as Zone 1, stage 1 or 2 without plus disease or Zone 2, stage 3 without plus disease.

**INDICATIONS FOR LASER TREATMENT**

Type 1 ROP will need laser treatment as described below within 72 hours of detection.

Aggressive posterior retinopathy (AP-ROP) will need laser treatment as described below within 48 hours of detection.

**INDICATIONS FOR SURGICAL REPAIR**

Stages 4 and 5 will require surgical repair of retinal detachment with scleral buckling, lens sparing vitrectomy with or without Preoperative Intravitreal AntiVEGF or combined lensectomy + vitrectomy.

Treatment with Indirect Laser Photocoagulation:

Indirect laser photocoagulation is done using topical anesthesia in the operation theatre or NICU with constant cardiac and respiratory monitoring by the anaesthetist or paediatrician.

Laser treatment anterior to the ridge to the entire avascular retina up to the ora. Treatment to be instituted within 72 hours of detection.

If zone 1 or posterior zone 2 disease, then split the treatment into two sessions. In session one cover three to four rows immediately anterior to the ridge. In session two cover the remaining avascular retina.

Topical steroid with or without antibiotic is prescribed in q.i.d dosage for five days.

**SURGICAL MANAGEMENT**

Scleral Buckling in ROP:

- Surgical repair of retinal detachment with scleral buckling done for Stage 4a /4b/ rare cases of stage 5
- Explant used is 240 band
- Scleral tunnels are made
- Placement of the band at site of highest ridge
- Indentation facilitated by paracentesis
- Removal of buckle or band cutting - approximately at one year age to prevent erosion into developing eye

**VITRECTOMY IN ROP**

Lens sparing vitrectomy with or without
Preoperative Intravitreal AntiVEGF or combined lensectomy + vitrectomy.

Intravitreal AntiVEGF is given in half the adult dose (0.625mg 0.75mm to 1mm from pars plana) if required after explaining the possible risk in O.T following sterile precautions under topical anesthesia

“Currently AntiVEGF is used for failed laser therapy or prior to surgery in very florid disease rather than as primary treatment.

FOLLOW UP

If initial fundus exam was normal and in cases with spontaneous regression of ROP as well as laser induced regression of ROP, repeat exam after six months to see indications of myopia, strabismus, amblyopia.

Watch for delayed complications like macular dragging, cataract, glaucoma or retinal detachment later on.

If significant refractive error is present as mentioned below - correction of the same with glasses is mandatory:

Myopia of more than ≥ – 4.00 D

1. Hyperopia with no manifest deviation of ≥+6.00D
2. Hyperopia with esotropia ≥+2.00 D
3. Astigmatism of ≥ 3.00 Dcyl
4. Any anisometropia of ≥ +2.5 Dsp / ≥ - 2.5 Dsp / ≥ 2.5Dcyl
Annexure: I

SANKARA NETHRALAYA
18, COLLEGE ROAD, CHENNAI – 600 006
R. O. P. EVALUATION FORM

Patient Name ____________________________  MRD No. ____________________________
Gestational Age _________________________  Birth Date ____________________________
Weight ________________________________  Exam Date ____________________________

ANTERIOR SEGMENT
- Iris ruberosis
- Corneal abnormality
- Suspect glaucoma

FUNDUS

<table>
<thead>
<tr>
<th>ZONE 1</th>
<th>ZONE 2</th>
<th>ZONE 3</th>
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<tbody>
<tr>
<td>OD</td>
<td>OS</td>
<td>OD</td>
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<tr>
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</tbody>
</table>

Vitreous hemorrhage
plus disease
pre-threshold
(zone 1 any stage, zone 2 with stage 2+, zone 3 or
zone 2 stage 3+ but not reaching threshold clock hours.
Need to examine in one week)
threshold
(zone 1 or zone 2 with stage 3+, 5 contiguous sectors or
8 composite sectors. Cryotherapy within 72 hours.)

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<tr>
<th>OD</th>
<th>OS</th>
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<td></td>
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<tr>
<td>yes</td>
<td>yes</td>
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<tr>
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</table>

OD Immature, no R.O.P. ___________  Mature ___________
R.O.P. Higher stage ___________  Lowest zone ___________  Total number clock hours ___________
OS Immature, no R.O.P. ___________  Mature ___________
R.O.P. Higher stage ___________  Lowest zone ___________  Total number clock hours ___________
Re-examine in ___________ weeks.

Physician’s Signature ____________________________
Flow Chart: 1

Initial Visit 3-4 weeks

- Normal up to Ora
  - Follow up 3-6 months

- Avascular Retina No ROP
  - Follow up 2 weeks
  - Progress to ROP

- ROP identified
  - Regressing ROP
  - Weekly follow up
  - ROP needing treatment

Flow Chart: 2

ROP on treatment with Laser

- Regressed ROP
  - AntiVEGF

- Persistent Plus
  - Extramacular Traction
  - Progress to ROP

- Progressed TRD
  - Posterior Traction
  - Stage V
  - Lensectomy + Vitrectomy
  - Lens sparing Vitrectomy

- Stage V
CONDITIONS CAUSING ROD – CONE DYSFUNCTION

- Leber’s Congenital Amaurosis (LCA)
- Typical retinitis pigmentosa (RP)
- Congenital stationary night blindness (CSNB)
- Melanoma-associated retinopathy
- Cancer-associated retinopathy
- Gyrate atrophy and choroideremia

CONDITIONS AFFECTING CONE – ROD DYSFUNCTION

- Stargardt’s disease
- Fundus flavimaculatus
- Atypical’ RP
- Bests’ disease
- Adult vitelliform
- Pattern dystrophies
- Dominant drusen
- Rod monochromacy and S-cone monochromacy

TESTS DONE FOR ROD – CONE DYSFUNCTION

- Best-corrected VA
- Contrast sensitivity (e.g. Pelli-Robson, low contrast VA)
- Color vision (e.g. Standard D15, Desaturated D15)
- Peripheral visual field assessment (full-field static screening)
- Dilated fundus examination

FAMILY HISTORY

- To establish an inheritance pattern
- A retinal dystrophy should be suspected based on family history, fundus appearance and/or specific patient symptoms, particularly if bilateral

PRESENTING SYMPTOMS OF ROD – CONE DYSFUNCTION

- Decreasing night vision (night blindness)
- Peripheral visual field loss
- Poor light/dark adaptation
- Defective Color vision

PRESENTING SYMPTOMS FOR CONE – ROD DYSFUNCTION

- Decreasing visual acuity
- Decreasing contrast sensitivity
- Defective Color vision
- Central visual field loss
- Poor light/dark adaptation

RETINAL DYSTROPHIES

Inherited retinal dystrophies are many and varied, encompassing RPE (retinal pigment epithelium) and photoreceptor-based diseases.

They principally affect, or initially affect either rod (known as ‘rod-cone’) or cone (known as ‘cone-rod’) function.

Depending on the type of dystrophy, central or peripheral vision may be affected first, or scotopic versus photopic visual function.

Advanced stage retinal dystrophies are usually associated with low vision or legal blindness.

Some inherited retinal dystrophies are described as ‘stationary’ but are slowly progressive.

Nystagmus is the most definitive presenting sign of a hereditary retinal disorder. Poor visual function may be the presenting abnormality in a young child, and school-aged children with retinal disease may present after a failed vision screening.

PRESENTING SYMPTOMS OF ROD – CONE DYSFUNCTION

Dysfunction

- Decreasing night vision (night blindness)
- Peripheral visual field loss
- Poor light/dark adaptation
- Defective Color vision

PRESENTING SYMPTOMS FOR CONE – ROD DYSFUNCTION

Dysfunction

- Decreasing visual acuity
- Decreasing contrast sensitivity
- Defective Color vision
- Central visual field loss
- Poor light/dark adaptation

FAMILY HISTORY

- To establish an inheritance pattern
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FAMILY HISTORY

- To establish an inheritance pattern
- A retinal dystrophy should be suspected based on family history, fundus appearance and/or specific patient symptoms, particularly if bilateral
• Optical coherence tomography
• Fundus autofluorescence
• Dark adaptation
• Electroretinography (full-field flash/pattern/multifocal) and/or electro-oculography

TESTS FOR CONE – ROD DYSFUNCTION
• Best-corrected VA
• Contrast sensitivity (e.g. Pelli-Robson)
• Color vision (e.g. Standard D15, Desaturated D15)
• Central visual field assessment (e.g. Humphrey 24-2, 10-2, Macula)
• Macula photostress test
• Dilated fundus examination
• Optical coherence tomography
• Fundus autofluorescence
• Dark adaptation

Electroretinography (full-field flash/pattern/multifocal) and/or electro-oculography

Management of these patients revolves around early diagnosis and specialized genetic counseling in order to decrease morbidity through optimal preventative care.

Treatment options for these conditions are limited and tend to be focused around optometric visual rehabilitation where possible (e.g. use of low vision aids, orientation and mobility training).

PATIENT EDUCATION

Once diagnosed with a retinal dystrophy, affected individuals should be educated about the condition and the likely prognosis. Individuals should be made aware of possible treatment options.

REVIEW

Regular review is to be done to consider medical or surgical interventions that may be beneficial during the disease course, and to exclude ocular comorbidity.

Testing should include a specific focus on associations with the individual’s disease

Review is beneficial with regard to maximizing visual function and testing should always involve at least:

• Careful refraction
• Assessment of the need for low vision
• Appropriate tests

REVIEW SCHEDULE

• Developed on an individual basis
• Most tests should be performed every 1 to 2 years

ELECTROPHYSIOLOGICAL TESTING

• To be done under GA for < one year
• Unreliable in children < one year
• To be repeated every two to three years to assess the progressive course of the disease

EMERGING MANAGEMENT CONSIDERATIONS

New management options for inherited retinal dystrophies ranging from gene therapy and oral or topical interventions designed to slow photoreceptor degeneration, through to stem cell transplants and bionic eyes under trial should be informed to parents and if approved in future will be contacted for same.

GENETIC TESTING

Genetic testing to be done for selected inherited retinal dystrophies which can help determine the likelihood of an asymptomatic family member developing the retinal dystrophy. It can also be useful for family planning decisions.
VISION REHABILITATION
The procurement of and training in the use of appropriate low vision aids. It should focus on reading, activities of daily living

ORIENTATION AND MOBILITY
Orientation and mobility instruction, where appropriate, should address the risk of falls and safety of the individual by assessing and modifying environmental and/or behavioral factors.

VOCATIONAL GUIDANCE
Vocational planning assistance is given to individuals experiencing severe vision loss, especially during school age

COUNSELING
Emotional and psychological well-being should be addressed using a multidisciplinary approach. Appropriate certification to be provided with a view to granting entitlements (pensions, benefits and travel concessions) to those with any visual impairment and their carer/s.

STARGARDT’S DISEASE
**Description:** Also known as juvenile macular dystrophy, this is the most common form of inherited macular degeneration and accounts for 7% of all retinal dystrophies.

**Inheritance:** Mainly AR but there is a rare AD variant.

**Presentation**
- childhood (about six years old) to early adulthood
- bilateral (usually) decreased central vision. This is often out of proportion to the clinical picture and these children may initially be labelled as malingerers
- There is also progressive Color blindness

**Signs**
- A relatively normal looking fundus except for a heavily pigmented RPE
- Atrophic macular degeneration - bull’s eye appearance as a result of atrophy of RPE

around a normal central core of RPE, a ‘beaten metal’ appearance, pigment clumping or marked geographical atrophy
- Normal visual fields in most cases
- ERG – normal in early stages, becomes abnormal in later
- EOG – subnormal

**Differential diagnosis**
- Fundus albipunctatus
- RP albescens
- Drusen
- Cone dystrophy
- Batten’s disease
- Chloroquine
- hydroxychloroquinemaculopathy

**Work – Up**
- History – age at onset
- Fundus examination
- FFA – silent choroid due to lipofuscin in RPE cells
- ERG and EOG
- Visual fields

**Treatment**
- Low vision aids
- Genetic counseling

**Prognosis**
generally is poor. Once vision drops below 6/12, progression is rapid and the visual prognosis is poor. However, active steps in visual rehabilitation can achieve and maintain some degree of independence.

JUVENILE BEST’S DISEASE
**Description:** This rare condition is also known as vitelliform (macular dystrophy. There are distinct, identifiable stages in this disease.

**Inheritance**
- AD with variable penetrance
- Carriers may have normal fundus but abnormal EOG
Presentation
- Decreased vision or asymptomatic
- Characterized by a yellow, round subretinal macular lesion which grows over years, eventually to give rise to a characteristic round egg-yolk appearance (lipofuscin) and which may be later associated with a pseudo-hypopyon
- Bilateral lesions located at fovea of 1 – 2 disc diameters in size
- Subnormal changes showing severe loss of light response occur in EOG readings in children before they are symptomatic or anything is seen clinically
- Lesions degenerate in 20% and may develop CNV, hemorrhage and scarring

Work – Up
- Family history - examine family members
- Fundus examination – macula with 90 D lens
- EOG – highly specific, detects carrier state of the disease
- ERG - Normal
- FFA – to detect CNV

Treatment
- Amsler’s grid given and instructed on its use and return immediately if change noted

Prognosis
- Declining visual acuity may be a reflection of macular scarring.

LEBER’S CONGENITAL AMAUROSIS
Description: Group of hereditary (usually autosomal recessive) retinal diseases that affect the rods and cones.
Inheritance: AR.

Presentation
- Severe vision loss noted in infancy. Vision ranges from 20/200 to bare light perception in most patients
- Nystagmus
- Poorly reactive pupils
- Exhibit the characteristic ‘oculodigital sign’: Constant rubbing of the eyes results in orbital fat resorption and subsequent enophthalmos (eyes sunken into sockets)
- Ocular features: Blindness, hypermetropia, keratoconus, keratoglobus, early cataracts
- Funduscopic appearance - a normal appearance, particularly in infancy; to pigment clumping in the retinal pigment epithelium (RPE)

ERG – Extinguished
- Nervous system - learning disabilities, deafness, epilepsy
- Other systems - renal and musculoskeletal abnormalities, endocrine dysfunction
- Associated systemic diseases - Alstrom syndrome, Battens disease (neuronal ceroid-lipofuscinosis), Joubert syndrome, peroxisomal diseases (Zell wagner disease, neonatal adrenoleukodystrophy, and infantile Refsum disease), and SeniorLoken syndrome

Genetic Testing: To predict prognosis and counseling

Prognosis
- Very poor

CONGENITAL STATIONARY NIGHT BLINDNESS
Description
- Group of non progressive retinal disorders characterized predominantly by abnormal function of the rod system

Inheritance
- Depending on the subtype, may be AD, AR or XL (most common)

Presentation
- Nyctalopia
- Presents in infancy, with myopia, nystagmus and strabismus with normal fundus in XL and AR
- Dark adaptation – Abnormal
- ERG pattern - “Negative” Dark-adapted ERG: a large a-wave and a reduced (negative) b-wave
Oguchi disease and fundus albipunctatus are forms of CSNB with abnormal fundi.

Prognosis
- There is no progression

CONGENITAL MONOCHROMATISM

Description
- This is used to describe various degrees of rod monochromatism or cone monochromatism

Inheritance
- Depending on subtype, AR or XL

Presentation
- Poor color vision, poor central vision, nystagmus, hemeralopia and photophobia in rod monochromatism
- Color vision – Abnormal
- Fundus – Normal, with absent foveal reflex
- ERG – Extinguished cone responses but normal rod response
- There may be some Color perception in incomplete rod monochromatism.
- Cone monochromatism is associated with better visual acuity (6/6 to 6/9) than rod monochromatism
- Treatment
  - Dark glasses/red glasses
  - Low vision aids
  - Prognosis - There is no progression.
  - Retinitis Pigmentosa

AD – Least severe
X R – Rare, most severe

Work – up
- Family history diagnosing and counseling purposes
- Visual fields
- ERG – In mothers of male patient (women carriers)
- Serum phytanic acid to r/o refsum's disease if neurologic abnormalities is present
- Lipid profile, serum protein and peripheral blood smears for acanhocytosis – abetalipoproteinemia
- Kearns – Sayre syndrome – ECG for heart blocks

Treatment
- Genetic counseling
- Tinted glasses
- Low vision aids and vocational rehabilitation

Prognosis
- Disease is progressive. Guarded visual prognosis.Apart from diagnosing and counseling on inheritance, Almost all the children of retinal dystrophies should have consultation with the vision rehabilitationist especially on the mode of their education
Under general anesthesia with a good assistant and nursing staff and a good microscope surgery should be performed. Wound involving only the cornea and or limbus interrupted 10'o nylon sutures are used.

- Any exposed iris / uveal tissue should be abscised
- Iris tissue must be cleared away from the wound
- All the sutures buried
- Should avoid intraocular manipulations
- Should ensure formed globe

**WOUND EXTENDING TO THE SCLERA**

- Need a good exposure to visualize the total extent
- The wound should be first approximated at the limbus and then sutured on either sides

**SCLERA TEARS**

- The clue to identify the location of the tear through an intact conjunctiva is to look for localized or ecchymosis
- In case of inability to localize the probable site, it's useful to follow and order by making peritomies and exploring the globe with minimal dissections and hooking of the recti where necessary
- Very rarely a wound may be impossible to localize which may mean a very posterior dehiscence which may not be amenable to repairing by the anterior approach.
- Once the extent is indentified 6'o vicryl interrupted sutures are used to repair the sclera
- When the wound extends under an extraocular muscle it gives better exposure to first put placement sutures with 6'o vicryl on the muscle, disinsert it then do the sclera suturing and finally make sure to suture back the muscle to its insertion

**PEDIATRIC TRAUMATIC CATARACT MANAGEMENT TIMING**

**DURING PRIMARY REPAIR**

- Best avoided
- Only if capsule ruptured with lens matter in
the anterior chamber

- Very small corneal wound with traumatic cataract and normal posterior segment at presentation in a very young child – this can help early rehabilitation and avoid a second anesthesia when anyway an intraocular lens implantation is not an option
- All other occasions it is best to plan cataract management after primary repair

**IMMEDIATELY AFTER PRIMARY REPAIR (FIVE DAYS TO TWO WEEKS)**

- When the globe is intact and in a more elective manner cataract management is preferred
- Without implanting intraocular lens (IOL)
- Younger than two years of age
- Corneal sutures interfere with IOL power calculations but cataract has to be removed due to inflammation or intraocular pressure issues
- Corneal sutures interfere with IOL power calculations but cataract has to be removed due to impending risk of irreversible amblyopia
- When the capsular support is inadequate
- In less than six year old posterior capsule management is also necessary leaving a rim of capsule for future IOL implantation
- With IOL implantation
- Preferred whenever possible
- Peripheral corneal wound which doesn't interfere with IOL power calculations

**ELECTIVE CATARACT MANAGEMENT (LATER THAN SIX WEEKS)**

- Any child above six years of age
- After suture removal and when able to get a reliable IOL power

**PROCEDURE**

- When IOL implantation is not planned
- A bimanual limbal aspiration is done with irrigation aspiration probe
- Capsule can usually be managed with the help of instruments like curved intraocular scissors, capsular forceps, vitrectomy cutter, etc.
- This ensures minimal entry wounds and a closed chamber
- Posterior capsule is also opened at least 5 to 6 mm with whichever instrument possible and a limited anterior vitrectomy performed
- When planning to implant IOL the lens aspiration is best done bimanually and once capsular integrity is ensured and IOL placement confirmed the main entry can be made
- Wound should be sutured with 10"o vicryl or nylon sutures whenever indicated
- Corneal wound integrity is checked before closing
- Additional procedures like pupilloplasty, iridodialysis repair, etc, must be managed concurrently
- An indirect ophthalmoscopy to evaluate the posterior segment in all trauma patients

**IOL POWER CALCULATIONS**

The challenge is mainly in obtaining a reliable keratometry value

Clear cornea – routine method using auto/manual keratometry and standard formulas like SRK 2
- If corneal sutures present – to wait for two weeks after suture removal
- Manual K/topography or SIM K
- Routine formulas
- Parents should be primed about the probability of requiring contact lenses for the residual astigmatism

**CHOICE OF IOL**

- If in the bag standard single piece hydrophilic acrylic lenses
- If in the sulcus three piece acrylic lenses or PMMA lenses depending on the adequacy of the capsular support
- Sclera fixated lenses in children older than eight in the absence of capsular support

**VISUAL REHABILITATION**

- Contact lenses whenever IOL has not been
implanted once the corneal sutures have been removed

• Glasses even earlier if age is highly amblyogenic
• Secondary IOL implantation as early as reliable IOL power calculation can be made wherever possible
• Along with refractive correction, parallely patching regime according to the age and severity of amblyopia has to be started
• Regular follow ups

PEDIATRIC LOW VISION CARE

INTRODUCTION
The major causes of blindness in children vary widely from region to region, being largely determined by socio-economic development, and the availability of primary health care and low vision care services. The prevalence of blindness in children ranges from approximately 0.3/1000 children in affluent regions to 1.5/1000 in the poorest communities. Reliable population-based data on the causes of blindness in children are difficult to obtain in developing countries. There is an increasing awareness about the needs of students with low vision, particularly in developing countries where programs of integrated education are being developed. However, the appropriate low vision services are usually mandatory in order to improve their residual vision.

DEFINITION OF LOW VISION
A child with low vision is one who has impairment of visual functioning even after treatment and/or standard refractive correction, and has a visual acuity of less than 6/18 to light perception, or a visual field of less than 10 degrees from the point of fixation in the better eye. But who uses, or is potentially able to use, vision for the planning and/or execution of a task for which vision is essential (WHO, 1992).

IMPACT OF LOW VISION
Functionally, low vision is described as irreversible visual loss and a reduced ability to perform many daily activities, such as recognizing people in the street, reading blackboards, writing at the same speed as peers, and playing with friends.

CAUSES OF LOW VISION
The major causes of visual impairment among children includes Stargardt’s disease, Myopic degeneration, Oculocutaneous Albinism, Retinitis Pigmentosa, Maculopathy, Optic Atrophy, Corneal opacities, Rod cone dystrophy and other heredomacular degenerations.

CLASSIFICATION OF CONDITIONS CAUSING LOW VISION
There are various ocular conditions that cause low vision. These conditions may be congenital or acquired. The number of conditions is too large to list here. However, they can be broadly classified in terms of the impact on what the person with low vision sees.

These categories are: Overall blurred vision Central field loss Peripheral field loss Multiple field loss

<table>
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<th>Category</th>
<th>Corrected VA-Better Eye</th>
<th>WHO Definition</th>
<th>Working</th>
<th>Indian Definition</th>
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<tr>
<td>0</td>
<td>6/6-6/18</td>
<td>Normal</td>
<td>Normal</td>
<td>Normal</td>
</tr>
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<td>Visual Impairment</td>
<td>Low Vision</td>
<td>Low Vision</td>
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<td>Severe Visual</td>
<td>Low Vision</td>
<td>Blind</td>
</tr>
<tr>
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<td>Blind</td>
<td>Low Vision</td>
<td>Blind</td>
</tr>
<tr>
<td>4</td>
<td>&lt;1/60- PL</td>
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<td>Low</td>
<td>Blind</td>
</tr>
<tr>
<td>5</td>
<td>NPL</td>
<td>Blind</td>
<td>Total Blindness</td>
<td></td>
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</tbody>
</table>
PEDIATRIC LOW VISION CARE

The first thing the clinician needs to understand is that the final management in the low vision care clinic can have no impact on the ocular condition of the child. A child is referred to the low vision clinic after being diagnosed with a condition that cannot be improved further with treatment. The management aims to improve the way that the existing vision is already being used by the child. Therefore, the low vision examination has two primary goals – a) to identify and understand how well the child uses residual vision (or) functional vision assessment b) to explore conditions or modifications for maximizing or enhancing visual performance.

LOW VISION EXAMINATION

Steps in examination of child with low vision:
Observation – Observe how the child utilizes vision for moving or to locate an object or for communication from the time of entry into the clinic.
Interview [History taking] – Understand the difficulties the child has in utilizing vision for visual tasks and identify visual tasks that are important for the child to execute.
Assessment/Functional vision- Clinical assessment of visual functions – Visual acuity, contrast sensitivity, color vision, visual fields.
End-point of the above low vision examination: Goal setting.

EXTERNAL OBSERVATION

The foremost step towards assessing a child with low vision begins even before the child enters the room. The clinician must carefully observe the mannerisms, visual habits and body language of the child. The cues that an experienced practitioner can pick up from this initial assessment go a long way in successful counseling and management of the child.

Details to observe for before beginning the low vision evaluation:

Level I: In the waiting room/ waiting area

How actively does the child use vision to gather
input from the surrounding?
- Does the child try to actively observe what is going on?
- Does child make visual contact while interacting with family members/attender?

**Level II: On entering the examination room**
How does the child navigate the environment?
- With the help of the care giver?
- With the help of a cane?
- Tries to use tactile input by trailing fingers along walls or furniture
- Is independent but visually (with or without additional head movement) scans the environment for obstacles
- Has poor navigation skills: Bumps into objects
- Walks independently, confidently without any aid

**Level III: Mannerisms/Posture**
- Head down: [may be due to glare or reduced inferior field of view]
- Squeezing eyes: Uncorrected refractive error/glare
- Chin up/ Chin down posture
- Head nodding
- Eccentric viewing / Fixation
- Eye-poking/Rubbing
- Presence of nystagmus with/without compensatory head postures

**Level IV: Physical Appearance**
- Shoddily dressed
  - Mismatched colors
  - Improperly buttoned
  - Poorly tied shoelaces
- Untidy clothes
- Unkempt appearance - Matted hair
- Spilled food stains on clothes of geriatric population
- Frailty
  - Any leg/arm weakness [Favours a particular leg while walking or a particular hand for holding reading material]
- Tremors
- The last two are particularly important for deciding in the use of handheld devices.
- Children diagnosed to have retinitis pigmentosa
- Obesity
- Polydactyly
- Clubbed fingers [syndactyly]
- Albinism:
  - Sunburn
  - Nystagmus
- Any unhealed lesions or deep abrasions on skin [may have poor platelet aggregation]

**Level V: While interacting with the child**
- Does the child expect the care giver to be in close proximity? Is the child dependent on caregiver for the visual task?
- Does the child interact directly with the examiner?
- Mode of exploring surroundings – Tactile/Auditory/Visual: Children with profound visual impairment may begin to depend on other senses to explore their surroundings, or continue to use vision – understanding their method for sensory input could help in suitable counseling on the mode of education
- Voice modulation: Does the child talk with halts/in a monotone?
- Does child make eye contact while talking or at least attempt to fixate eccentrically
- Child is enthusiastic about the outcome of the test/does not interact at all/is not interested in the test
- Attempt to gauge the expectations of the child: high/reasonable/low

**Level VI: While interacting with the care giver**
- Is the care giver/family aware about the ocular condition of the child
- Are they over protective/deny care

**HISTORY TAKING**

**Child Details**
- Age
- Occupation
• Living situation and main care giver [number of family members, care given, source of family income gives a general idea about the child's psychological outlook, need for independence and how much support will be available from the family]

• General health (Diabetes, Hypertension, following trauma or surgery, are important determinants of success of low vision management and also influence prognosis of the ocular condition) – in case of acquired conditions or worsening conditions, it would be a good practice to know when it was detected, specific milestones in disease history (worsening, surgeries, systemic/visual disability onset)

• Relate ocular conditions to systemic syndromes, especially those that can be potentially life threatening. For example: metabolic disorders, Wilms tumour in aniridia, syndromes in children that can have impact on developmental milestones such as Bardett-Biedl Syndrome in Retinitis Pigmentosa, etc

• Document family history of consanguinity or ocular disease to understand the mode of inheritance and the prognosis of the condition.

• Other limitations such as physical handicap, hearing impairment, mental retardation

Previous Low Vision Care

• Has the child tried any device/devices before
  - Type of device
  - Details (Magnification/Color of tint)
  - For what purpose
  - How useful was it/ Success with device
  - Frequency of use
  - Duration of use
  - Does patient have/know about disability certificate
  - Used associated concessions/rights?

This gives an idea of what the child has tried before and how much success or failure has been faced on previous exposure to low vision care. Also, it would be a guideline to understand the child's demands and visual tasks. Details about disability concessions would inform the practitioner about how well educated or well informed the subject is about the ocular condition or the government's facilities for the same.

Difficulty with Visual Tasks

The most important thing to discern is about the onset of difficulty with visual task and whether the problem is progressively worsening, stable or if the vision is improving.

Visual tasks are divided into three categories:

• Distance
• Intermediate
• Near

Distance visual tasks include tasks such as

• Face recognition
• Seeing blackboard [For students]
• Seeing PowerPoint displays
• Seeing signboards/bus numbers/ shop names/ street names
• Seeing curbs or steps
• General sight seeing
• Near visual tasks may be broadly classified as:
  - Seeing textbooks/ notebooks [School children]
  - Reading office print/ handwritten material at the office
  - Reading newspapers/ novels/ magazines
  - Reading bills/ price tags/ medicine labels
  - Using mobile phone

The examiner should take care to distinguish between difficulty in reading a text and difficulty in prolonged reading or reading in bright/dim light.

Writing tasks such as

• Signing, filling accounts
• Generally children with field loss have will problems writing along a straight line or complain of overlapping of letters while writing

Intermediate visual tasks

• Using computers/mobile phones
• Problems with computers may arise from:
  - Difficulty with contrast [due to impaired contrast sensitivity]
  - Difficulty finding options on screen [due to peripheral field loss]
• Skipping lines or mixing up lines [due to central field loss]
• Reading text on screen [reduced near vision]

LIGHT SENSITIVITY
Various ocular conditions causing low vision cause problems such as:
- Photophobia
- Difficulty seeing in dim light
- Delayed dark adaptation
- Delayed light adaptation
- Glare – Veiling / Disability glare
Knowing the child's light sensitivity, one can help in modifying the daily environment of the child, providing non optical devices such as filters or peaked caps to cope with dim light, etc.

MOBILITY TASKS
Differentiate between difficulty with navigating in familiar and unfamiliar environments to difficulty only with moving around in dim light and brightly lit surroundings
Also question what compensating techniques the child uses such as:
- Having an assistant
- Help of the care giver
- Use of walking stick / cane
- Does the child just sit at home due to mobility problems?
This question guides the practitioner in deciding the best mode of intervention for difficulty with mobility and determining the need for orientation and mobility training.

ACTIVITIES OF DAILY LIVING
Activities of daily living [ADL] are those activities that are a part of daily life and are an absolute necessity:
- Personal grooming
- Personal hygiene
- Finding food on plate and eating
- Currency identification
- Inserting keys into doors
- Matching colors of clothes, etc
Various techniques can be taught by rehabilitation therapists when non optical devices do not help patients with low vision / visual impairment to perform activities of daily living independently.

IDEAL VISUAL ACUITY CHART IN LOW VISION CLINIC
- Standardized testing at different distances (LogMAR)
- Equal number of letters on each line (more than 3)
- Equal distance (same as letter height) between letters on a row
- Space between two rows equals letter height of smaller row
- Contrast of letters to background 95% or more

RECOMMENDATIONS FOR VISUAL ACUITY TESTING
- Chart lighting: 85 Cd/m²-300 Cd/m²
- Use variable lighting to assess optimum lighting for best visual acuity
- Start at close working distance
- Test better eye first, then worse eye and then binocularly. Document whether monocular (which eye) or binocular performance is better
- Allow abnormal head postures and eccentric viewing
- Do not point to letters or provide cues – allow to skip letters on a line (gives an idea of letters being skipped on a line due to scotoma)
- Allow time to scan and coax where required
- Positively encourage further reading. Pointing to a letter, expecting a better performance on the test should be at the end and both visual acuities should be documented.
- Use of pinholes is not recommended when visual acuity is assessed at less than four meters.(less than four meters cannot be considered optical infinity and therefore may not yield correct results for paraxial approximation. However, pinholes of larger aperture sizes are still used in some low
vision clinics to detect uncorrected refractive error. In the case of patients who have sufficient vision to respond at four meters or larger distances may not always perceive an improvement especially in cases of field loss (especially central) or impaired contrast sensitivity (due to luminance decrease with pinhole).

- Large aperture pinholes are available for special use in the low vision clinic where indicated.

**Note:** The need for visual acuity testing in the low vision clinic is to get an idea of functional vision or how the patient uses his vision in daily life and to also identify the smallest size of letters that can be read in ideal conditions such as a close working distance or given adequate time. Commonly used visual acuity chart in the low vision clinic Bailey Lovie high contrast visual acuity chart

![Bailey Lovie high contrast visual acuity chart](image)

- One of the earliest charts used to implement logarithmic progression for letter size
  - Letters have equal legibility. The letters are combinations from a 10-letter set.
  - Uses five Sloan sans-serif letters per line
  - Equal spacing between characters (same as letter height), uniform spacing between rows

(same as letter height of next row)
- Logarithmic progression of text – letters double in size every three lines
- If the chart is moved closer by 0.1 log steps, the subject will read an additional row
- Each letter can be scored to calculate final visual acuity score. (0.02 per letter, 0.1 per row)

Berkeley Rudimentary Vision test kit (Bailey, 2012).
- Three pairs of cards (25 cm² area)
- First pair: Single tumbling E (STE) – 100M, 65M, 40M. 25M
- Second pair: Grating acuity-200M, 125M, 80M, 50M
- Third pair: White field projection, black-white discrimination

**SCREENING METHOD**

- **Step 1:** Show 25M single tumbling E(STE) at 100 cm → Pass → Use LogMAR
- **Step 2:** Fail 25M at 100 cm → Show 100M at 100cm → Pass → Assess rest of visual acuity with Ste (Visual acuity will be between 100 and 25M)
- **Step 3:** Fail 100M at 100 cm → Check with 100M at 25cm → Pass → Assess rest of visual acuity with STE at 25 cm
- **Step 4:** Fail STE at 25 cm → Use grating acuity 200M at 25cm → Pass → Assess visual acuity with grating acuity cards at 25 cm
- **Step 5:** Fail Grating acuity at 25 cm → Show Quad or Hemifield white projection in four quadrants of visual field → Pass → Document light projection or
- **Step 6:** Fail white field projection at 25 cm → Use penlight to assess light perception

Parameters to be documented when assessing visual acuity in a child with low vision - 1)
Letter size 2) Testing distance 3) Qualitative components - missing letters, detects on pointing, speed of reading, etc.

NEAR VISUAL ACUITY
Notations used in near visual acuity testing
N Notation (Point Notation)
• Non standardized
• Varies based on type of font
• 1 point – 1/72 of an inch (slug into which the text fits)
• Actual size of lower case text: 1 [point – 1/144 inch)

M NOTATION
• Sloan’s M notation can be converted based on the distance at which it is read.
• 1M subtends 5 minutes of an arc at 1 meter
• 8 points (N8) = 1M

SNELLEN EQUIVALENT
Near vision charts are calibrated for a certain working distance (usually 40 cm) and the corresponding Snellen acuity is given based on letter size.

TYPES OF NEAR VISION CARDS

Figure: MN read chart

• Single word
  – May be word, number or symbol
  – Example: Lighthouse “game” or number cards
• Continuous text
  – Word reading
  – Sets of unrelated words along a single line
  – Example: Bailey Lovie word reading chart
  – Continuous reading tests
  – A complete sentence of about 10 words – usually simple and makes sense
  – Example: MN Read Card (Minnesota Near Vision reading test)

recommendations for visual acuity testing for near
• Chart lighting: 85 Cd/m²-300 Cd/m²
  – use variable lighting to assess optimum lighting for best visual acuity
• Start at close working distance/allow patient to adjust for optimal comfort
• Test better eye first, then worse eye and then binocularly. Document whether monocular (which eye) or binocular performance is better
• Allow abnormal head postures and eccentric viewing
• Allow changing orientation of text – vertical orientation is easier to read for patients with macular degeneration
• Do not point to letters or provide cues – allow to skip letters on a line (gives an idea of letters being skipped on a line due to scotoma)
• Allow time to scan and coax where required
• Positively encourage further reading. If you feel that by pointing to a missed letter/word the patient may perform better on the test, do it at the end and document both visual acuities

• Parameters to document:
  – Letter size
  – Working distance
  – Reading speed: Number of words read per minute (document for smallest text size that can be read)
  – Critical print size: Minimum print size for maximum reading speed. (Up to a certain acuity level, the patient may read fast and the reading speed may then drop off slowly. It is necessary
to document this speed, as this is the speed the practitioner must aim to achieve with the use of the low vision device).

**SUBJECTIVE REFRACTION**

1) Begin subjective refraction with the value obtained from objective refraction in trial frame.

2) Use full aperture lenses

3) Use bracketing technique [Just Noticeable difference] to refine the endpoint
   - Just Noticeable Difference is the minimum power difference for which a patient will perceive a difference in quality of vision. For example: a person with 6/60 visual acuity may not be sensitive to ±0.25DS changes
   - The minimum lens power for which a person with 6/60 will perceive a difference [Just Noticeable Difference] can be calculated as follows:
     - Just Noticeable Difference [In Metric notation]: Denominator of visual acuity / 30. [In this case: 60/30 = 2D]
     - For Feet notation: Denominator/100 [in this case: 200/100 = 2D]
   - For this patient: The endpoint is arrived at by alternatively placing +1D and -1D in front of the eye and checking for improvement in vision [Range of +1D to -1D :2D]
   - For astigmatic errors:
     - Use Keratometry readings as a baseline
     - Select JCC of higher powers based on JND
     - Stenopeic slit of larger size can also be used to refine axis

**Note:** The endpoint of subjective refraction in children with low vision is not necessarily improvement in visual acuity. Question the child if there is a perceived improvement in quality of vision [say contrast], identifying objects, face recognition or contours in general

**CLINICAL TIPS**

- Always perform objective refraction using a retinoscope instead of an autorefractor
- Provide a suitable fixation target for retinoscopy
- In case of reducing room illumination for performing retinoscopy - provide sufficient time for light adaptation before beginning subjective refraction
- In case of people with high refractive errors or children already using habitual correction, refract over the glasses using clip-on trial frame clips (Halberg clips)
- Check if binocular acuity is better or worse than monocular visual acuity. If monocular acuity is better or preferred, it may be beneficial to prescribe two sets of glasses:
  - For mobility with preferred prescription for both eyes
  - For specific purposes where use of distance vision is required with one of the eyes occluded - Use a frosted glass or neutral density filter
- Preference for binocularity or monocularity may vary for distance and near. Check before prescribing occlusion for both

**CONTRAST ASSESSMENT**

Fixed contrast, variable acuity tests:
Bailey Lovie Low Contrast Visual Acuity Test:

![Figure: Low contrast Bailey Lovie chart](image)
• Regular LogMAR chart is printed at low contrast (Weber’s 18%, Michelson’s – 10%) to the background
• LogMAR format chart and letter size progression
• Difference of more than 2.5 lines in comparison to High Contrast LogMAR acuity → difficulty in low luminance conditions (Brown.B, 1989)
• Testing distance: Variable (begin at same distance as visual acuity assessment)
• Lighting: 80-200 Cd/m²
• This test is a good and quick tool to assess impairment of contrast sensitivity to low contrast levels or in environments with poor lighting

SCREENING FOR IMPAIRED CONTRAST
An alternative to assessing contrast sensitivity is to reduce the chart luminance to 10% of the original luminance level using a neutral density filter. This simulates a low luminance environment and thereby is an indicator of the subject’s performance in low luminance conditions such as cloudy days or the evenings. A difference in visual acuity of more than two lines could be considered impaired or reduced contrast sensitivity.

COLOR VISION

The practitioner must know if:
The patient faces difficulty in daily life for color identification or discrimination tasks
Has a congenital color vision defect and has already adapted to it

Has a color vision defect due to worsening of the ocular condition and is facing new difficulties in identifying and/or discriminating colors in daily life

The Farnsworth D15 test is a “Color Arrangement” test based on the principle of color saturation. Procedure:
• Normal room lighting (avoid yellow/tungsten light source)
• Subject is given 15 discs. The first disc is put in place by matching it to a fixed test disc. “Place the disc that looks closest or most similar to the fixed disc”
• The second disc now becomes the color which has to be matched and so on

Based on the color arrangement pattern, the examiner can identify proptanopes, deuteranopes, tritanopes and anomalous trichromats.
Most suited for the low vision clinic as it is adapted to have large discs
• Variable testing distance allowed
• Short testing duration
• Easy inference
• Can be administered for children / illiterates

Figure: Farnsworth Dichotomous - 15 (D-15)

Test report and sample protan, deutan and tritan defect reports
MISCELLANEOUS ASSESSMENT

OCULOMOTOR ASSESSMENT

Check for extraocular motility as limitations would interfere with eye scanning to compensate for field loss.

SACCADES AND PURSUITS

Saccades: Ability to shift fixation or refixate from one object to another

Test
- Hold two fingers a few inches apart
- Ask patient to shift fixation from one finger to the other and back a few times
- Look for smooth eye movements, quick refixation
- Pursuit: Ability to track an object
- Test:
  - Ask patient to look at a target such as a pencil, your finger, etc
  - Move a pencil or finger horizontally or vertically across
  - Check for ability to follow without losing track

Impaired saccades or pursuits could result in difficulty in using magnifiers comfortably for scanning text or tracking a line completely.

Impairment could also indicate damage to higher order centers such as neural pathways or the cortex. This is most usually seen following cerebrovascular accidents (strokes), diffuse cerebral atrophy and causing hemianopias, altitudinal field defects etc.

Part III

Low Vision Assessment for pre-verbal children

GOALS FOR LOW VISION EXAMINATION

1) Learning to Communicate

An infant with low vision may not be able to make eye contact or imitate the mother smiles/coos. This in turn will give poor feedback to the parents. It can also result in depression for the parents who are unable to bond with the baby and are already depressed with the idea of bringing up a baby with visual impairment. It can have a life-long impact on the parent-child relationship.

A child with low vision who does not make eye contact could be affected in peer relationships, may be misunderstood by parents to be stubborn and face many problems in peer-groups, school as well as the home.

2) Exploring Environment

An infant with low vision is exploring the environment and learning about colors, visual textures and recognizing items visually. The infant learns to name objects by looking and pointing at them. When infants have difficulty saying, parents are at a loss about teaching infants about the environment. This impacts the development of the infant. They may also fear stimuli that are scary or unfamiliar to them. Seeing clearly or contrast enhancement is essential to manage this aspect. Further, this is the period when the child begins to learn mobility skills. Necessary training during this time can have a major impact in visual developmental process.

For the child with low vision, various aspects in school and the surrounding are being explored. Mobility, learning to ride small vehicles like two wheelers are a part of this experience. Experiments in science and other components of study enhance understanding. Poor participation in these experiences can lead to insecurity and a sense of loss.

Aspects of vision that need to be evaluated have their application in:
- Communication
- Orientation and mobility
- Activities of daily living
- Sustained near vision tasks

The examiner must explore what type of
techniques will best help the infant/child to carry out the above tasks:

- **Blind**: Use sensory substitution techniques for the tasks
- **Low vision techniques**: Needs optical enhancement/magnification
- **Sighted techniques**: Can manage or needs environmental/contrast enhancement

Based on which of these techniques, the infant/child will be using most of the time, the examiner may have a better guideline to decide the mode of management.

Therefore, the goal of functional examination in pediatric population is to determine if their visual functions would be suitable for sensory substitution/low vision/sighted technique for a specific task.

Dr. Lea Hyvarinen recommends the following scoring for the techniques:

<table>
<thead>
<tr>
<th>Technique</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blind</td>
<td>1</td>
</tr>
<tr>
<td>Low Vision</td>
<td>2</td>
</tr>
<tr>
<td>Sighted</td>
<td>3</td>
</tr>
</tbody>
</table>

For infants, the activities of daily living and sustained near vision tasks could be combined. The total score could then be between 3-9. An infant with a score of 9 would be sighted while score of 3 would be using sensory substitution techniques most often.

<table>
<thead>
<tr>
<th>Points</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Functional Blindness</td>
</tr>
<tr>
<td>4</td>
<td>Profound Low Vision</td>
</tr>
<tr>
<td>5-6</td>
<td>Severe Low Vision</td>
</tr>
<tr>
<td>7</td>
<td>Moderate Low Vision</td>
</tr>
<tr>
<td>8</td>
<td>Mild Low Vision</td>
</tr>
<tr>
<td>9</td>
<td>Sighted</td>
</tr>
</tbody>
</table>

Based on this interpretation, the examiner must exercise judgement to determine appropriate management, mode of schooling, etc.

For school children, the scoring would be 4-12, as activities of daily living would be separate from near vision tasks.

Tools in low vision examination

- **Visual Acuity**
  - **Lea’s tests**
  - **Symbols**: House, heart, apple, circle
  - **Numbers**
  - **Grating acuity tests/paddles**
  - **HOTV**
  - **Teller acuity cards**
  - **Opto Kinetic Nystagmus Drum**

**REFRACTION**

Perform manual retinoscopy (use a single large and interesting lighted target in the room instead of an optotype)

- The reader is requested to refer to other literature dedicated to pediatric visual examination for further information.
  - Evaluate the quality of reflex without cycloplegia to understand
  - Type of error
  - Presence of opacities
  - Position of pupil and how dynamic accommodation is
  - Type of fixation

Use halberg clips if there is a habitual correction

Perform cycloplegic refraction to determine actual error (exercise care in use of cycloplegic agents and correlate with underlying systemic conditions)

**CLINICAL TIP**

Perform dynamic retinoscopy for all children to determine difficulty with accommodation. Most children are prescribed “approach magnification” or to use close working distance to read print at near. However, prolonged reading at close working distance can cause significant strain especially when there is difficulty with accommodation. The only way to pick this up is to perform dynamic retinoscopy.

**Method**

- Attach a target that is two lines above the near visual acuity of the patient to the retinoscope
- Ask the patient to look at a distant target. Observe the retinoscopic reflex
- Ask the patient to look at the target attached to the retinoscopy ahead. Observe time taken for accommodation to occur/change in retinoscopic reflex
- Perform dynamic retinoscopy at working
distance of the patient

- Contrast sensitivity
- Leas Low Contrast Cards
  - Lea’s symbols at different contrast levels
- Patti Pics
- Hiding Heidi

**COLOR VISION**

- D15

**Visual Field**

- Confrontation

Functional vision in infants/children with learning disability or multiple sensory impairment:

**Visual Acuity**

- Use small colored candy and look for ability to pick up.
- Small colored beads may also be used. In case of multi sensory impairment, move beads on a string and look for visual attention and/or tracking

**Clinical Tip**

- Tracking may not be smooth in children with multiple impairments, especially cerebral palsy

**Contrast**

- Roll balls of different contrasts on the floor and look for ability to track / loss of interest
- Look for ability to pick up beads of different colors from different colored surfaces (grey beads on a white paper, black beads on white paper, red beads on yellow paper and so on)

**Color**

- Use color pencils or building blocks and attempt matching

**Visual Field**

- Confrontation with large interesting toys.

**MAGNIFIERS FOR DISTANCE**

**Telescopes**

Optically telescopes can be divided into two types:

- Galilean telescope
- Keplerian telescope

Keplerian telescope [Atchison, 1996].

The Keplerian telescope consists of two convex lenses mounted such that:

1) The ratio of the focal length of the objective lens to the eyepiece forms the required magnification of the device

2) The tubelength of the device is the sum of the focal lengths of the objective and the eyepiece in the system.

As both the lenses used in a Keplerian telescope are convex lenses, the final image formed is inverted in nature. Therefore, an erecting lens or prism has to be included in the system to form an erect image. In addition, field lenses and aperture stops can be included within the system to shift the position of the exit pupil of the system, increase the field of view and minimize aberrations.

**Galilean Telescope**

The Galilean telescope consists of a convex lens used for the objective and a concave lens used as the eyepiece. The ratio of the focal lengths of the objective and eyepiece lens gives the magnification of the system. The final image formed is erect and virtual in nature. A Galilean telescope has lesser field of view when compared to a Keplerian telescope. However, it uses lesser number of optical components as no prisms or lenses are required for change in image orientation.

There are four types of telescope prescribed in the low vision clinic:

1) **Monocular Telescope:**

- These are used in front of a single eye
• Are portable
• Used for spotting tasks
• Can be used for copying from the blackboard in classrooms for students
• Can also be used for tourism and spotting
• Can be combined with a reading cap for near tasks
• Cannot be used for mobility

2) Binocular telescope
• Similar to monocular telescopes except for larger field of view due to binocularity
• Heavier than monocular telescopes
• Less compact
• Useful for spotting only
• Cannot be used for long duration due to weight and bulk
• Very useful for individuals who cannot tolerate occlusion due to nystagmus or reduced field loss

3) Ocutech telescope
This is a bioptic monocular telescope
The individual can use the optics of the spectacle for general tasks and look through the telescope only when there is an object of interest. Especially prescribed for driving – following rigorous training program and special driving test in countries where it is approved.
(Not approved in India)

MAGNIFIERS FOR NEAR
Spectacle magnifiers (+5D to +20.0D – higher plus can be prescribed subject to availability)
Hand magnifiers (1.2x – 1.4x)
Stand magnifiers (4x – 14x)
Dome magnifiers (1.8x – 2.2x)
Bar magnifiers (1.5x - 2.2x)
Fresnel sheet magnifiers (up to 3x)
The above mentioned magnifications refer to the equivalent power of the system and not manufacture mentioned magnifications.
Closed Circuit Television Systems (CCTV)
Spectacle magnifiers (Relative Distance Magnification):
Prescribing high ADD that can be incorporated in the spectacle up to +5.0D
Prescribing separate reading glasses with ADD higher than +5.00D.
If the spectacles are intended for binocular use, either decentration of the lenses or incorporation of base-in prism is necessary. This is because the interpupillary distance (IPD) will differ from that of near PD measured for 40 centimeters.
Clinical pearl
High powered lenses will have aberrations on moving away from the optical center of the lens. Therefore, decentration or incorporation of prisms is essential for best vision with the glasses. In case the patient has eccentric fixation or is not viewing the center of the lens, appropriate changes have to be made.
1 mm of base in decentration for every diopter of ADD, for each eye may satisfy the base in prism requirement of many cases for binocular devices.

Example
Distance IPD 64 mm. ADD 8D.
8 mm decentration = 8 Δ Base In for each eye's dist PD.
Distance IPD 68 mm. ADD 10D.
10 mm decentration = 10 Δ Base In for each eye.
The higher the addition, more the meter angle of convergence and therefore, the requirement for more base in prisms. If near P.D is considered, the base in prisms should be calculated for ADDs over +3.0 D only, i.e., for a 10D add deduct 3D and calculate for 7D only.
A rule of thumb is to incorporate two prisms more than the power in each eye. For example For +6.0D ADD, 8 prism BI in each eye would equal 16 prism BI.

<table>
<thead>
<tr>
<th>POWER</th>
<th>BASE-IN PRISM</th>
</tr>
</thead>
<tbody>
<tr>
<td>+6.0 D</td>
<td>8 prisms for each lens</td>
</tr>
<tr>
<td>+8.0 D</td>
<td>10 prisms for each lens</td>
</tr>
<tr>
<td>+10.0 D</td>
<td>12 prisms for each lens</td>
</tr>
</tbody>
</table>

Half eye frames can be used binocularly for reading powers of 6D – 10D. Half-eye glasses give the wearer freedom to look over the frame for distance visual tasks.
Beyond +10.0D binocularity may not be possible in spite of equal or near-equal visual acuity, primarily due to the close working distance.

Hand Magnifiers
A plus (Convex) lens is held at a distance from the object such that the object is at the focal length of the lens. This makes the object appear closer and larger than the actual size of the object:
1. The eye-to-lens distance and the lens-to-object distance can be varied making this a very flexible magnifier
2. The larger the eye-to-lens distance, the lesser the field of view and vice versa.
3. The larger the lens-to-object distance, lesser the magnification.
4. Can be prescribed in combination with a spectacle magnifier. The resulting magnification can be calculated using the formula for equivalent power: $F_\text{eq} = F_1 + F_2 - d F_1 F_2$ and the magnification = $F_\text{eq} / 4$ where $F_1$ and $F_2$ are the powers of the plus lens and the hand held magnifier and $d$ is the distance between the lens and the magnifier.
POCKET MAGNIFIERS

- As the name indicates, they are constructed to be carried around in the pocket
- These are hand-held magnifiers with slide-in mechanism into a case to protect the lens from scratching. The case itself functions as the handle of the “hand-held”
- They are intended for spot or quick reading.
- These are generally small aperture lenses

STAND MAGNIFIERS

- Option of choice for prolonged reading when higher levels of magnification are required

DOME MAGNIFIERS

These are also called Visolett or bright field or paper weight magnifiers. These are magnifiers with a plano-convex construction and have better light gathering properties than other optical low vision devices. They are only possible with low magnification up to 4.0X

Magnifiers with internal illumination are available
- Generally placed in contact with reading material. The height of the stand is the same as the focal length of the lens or lesser than the focal length of the lens
- If the height of the stand is less than the focal length of the lens, the patient will have to accommodate or require ADD to see clearly through the stand magnifiers
**BAR MAGNIFIERS**

These are similar to dome magnifiers but are bar shaped and long (usually the width of a page). They use plus powered plano-cylindrical lenses to enlarge text vertically. Light gathering properties are similar to that of the dome magnifier. This is especially useful for people with subnormal near acuity or normal near acuity but requiring an increase in contrast for comfortable reading. They are also of use for people with constricted fields.

![Figure 4.5: Line or Bar Magnifier](image)

**FRESNEL SHEET MAGNIFIERS**

These use fresnel sheets to magnify the image. (Plastic sheet with concentric grooves cut into it). Higher magnification levels are not possible with this type of system as an increase in magnification would also increase distortions in the image formed by the fresnel lens. They are thin, lightweight, pocket-size or page size and have good light gathering properties.

![Figure 4.6: Frenel Sheet Magnifier](image)

**CCTVs**

In CCTVs, a camera projects the image onto a screen. As these system display images on an electronic screen, it is possible to alter the contrast, color and size of the text to suit the user’s requirements.

**TYPES OF CCTVS**

1) **Table top CCTVs**

- Consists of a monitor or screen placed on a table
- Attached camera has a viewing tray on which reading material is placed. The text is displayed on a screen. (Example: TOPAZ)

![Figure 4.7: Table top CCTV (TOPAZ)](image)

- The Camera can also be attached to a small stand that can be rotated and focuses for a range of distances (Example: ONYX CCTV by Freedom Scientific). Instead of requiring an additional monitor, it can be connected to a PC

![Figure 4.8: Desktop CCTV (ONYX CCTV)](image)
2) **Mouse model**
   - The CCTV camera is hand held like a mouse and is attached to a television or PC screen
   - The text is placed under the mouse and displayed on the screen

3) **Head Mounted**
   - Similar to the mouse model - handheld camera
   - Screen is a binocular system that can be worn on the head in front of the eyes

4) **Portable**
   - These are small video magnifiers with screen sizes that are between two to five inches high.
   - The camera is inbuilt under the screen and the device can be moved directly over the material like a stand magnifier
Table discussing type of magnifier, type of magnification, available magnification levels and type of illumination possible with the given magnifier

<table>
<thead>
<tr>
<th>Magnifier</th>
<th>Type of Magnification</th>
<th>Magnification level</th>
<th>Illumination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectacle magnifier</td>
<td>Approach</td>
<td>1.5x – 6x</td>
<td>External</td>
</tr>
<tr>
<td>Hand magnifier</td>
<td>Approach</td>
<td>1.5x – 14x</td>
<td>Internal possible</td>
</tr>
<tr>
<td>Stand Magnifier</td>
<td>Approach + Angular</td>
<td>4x - 14x</td>
<td>Internal possible</td>
</tr>
<tr>
<td>Dome Magnifier</td>
<td>Approach + Angular</td>
<td>2x - 4x</td>
<td>Light gathering</td>
</tr>
<tr>
<td>Bar Magnifier</td>
<td>Approach</td>
<td>1x - 5x</td>
<td>Light gathering</td>
</tr>
<tr>
<td>Fresnel Magnifier</td>
<td>Approach</td>
<td>1x - 3x</td>
<td>Light gathering + External possible</td>
</tr>
<tr>
<td>CCTV</td>
<td>Real Image Magnification</td>
<td>upto 100X</td>
<td>Internal</td>
</tr>
</tbody>
</table>

Table showing most suitable tasks with specific type of magnifier

<table>
<thead>
<tr>
<th>Magnifier</th>
<th>Reading task</th>
<th>Spotting task</th>
<th>Writing task</th>
<th>Hands free</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectacle magnifier</td>
<td>✔</td>
<td></td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>Hand magnifier</td>
<td></td>
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<td>Stand Magnifier</td>
<td>✔</td>
<td></td>
<td>✔</td>
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<tr>
<td>Dome Magnifier</td>
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<tr>
<td>Bar Magnifier</td>
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<tr>
<td>Fresnel Magnifier</td>
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<tr>
<td>CCTV</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

**PRESCRIBING MAGNIFYING DEVICES**

Prescribing for Distance Visual Tasks

Formula to calculate magnification:

**Distance**

Magnification = Best corrected distance visual acuity

**NEEDED DISTANCE VISUAL ACUITY**

For example, the best corrected distance VA of a 10 year old boy is 6/36 and needed visual acuity to view black board is 6/12. Required magnification is 36/12 = 3 X

**Near**

Although there are several formulae to calculate the tentative magnification for near, the most acceptable formula which is in use nowadays is
the equivalent viewing power [EVP]

**The calculated magnification would be**

\[
EVP = \frac{\text{BCVA}}{\text{TVA}} \times \frac{100}{\text{WD}} \\
= \frac{12}{4} \times \frac{100}{30} \\
= 3\times3.33 \\
= 9.99D \\
= \sim10D \rightarrow \sim2.5X
\]

**The options for prescription would be**

A spectacle magnifier of +10.00D
A stand magnifier of 2.5 X magnification
A hand magnifier of 2.5 X magnification
A near telescope of 2.5 X magnification

In this case, the option of choice would be a spectacle magnifier or a stand magnifier as they are apt for continuous reading – such as for the newspaper.

Prescription of telescopes for near visual tasks requires a motivated patient who is very particular about working distance and is not worried about cosmesis or field of view.

**CLINICAL TIP**

The minimum field of view through the near magnifier should be 4-6 characters to ensure comfortable reading.

**NON OPTICAL MANAGEMENT**

A non-optical device is a device that increases the ease of performance of a task just by increasing size, increasing contrast, reducing glare or simply due to sensory substitution.

Non optical devices may be classified as follows:
- Relative size device
- Glare, contrast and lighting control
- Postural devices
- Hand writing and written communication device
- Orientation and mobility techniques and devices
- Sensory substitution device

- Medical management and life skill device
- Assistive technology- Computer and mobile modifications, computer and mobile softwares

**RELATIVE SIZE MAGNIFYING DEVICE**

These devices assist patients with low vision by mechanically increasing font size. For example, large print magazines, telephones, with large numbers, large size playing cards, jumbo clocks, large insulin syringes.

**Glare Contrast and Lighting Control Device**

- Filters
- Peaked cap for glare
- Use of table lamps to increase illuminance
- Typoscopes to improve contrast and cut off specular reflection
- Hand held torch in dimly lit environments
- Multiple pinhole spectacles: Useful for multiple corneal opacities for glare reduction

**TINTS AND FILTERS**

**Types of Filters**

**Contrast Enhancing Filters**
- Yellow or yellow-orange filters
- High absorption filters
- Red/Dark amber
- Green
- Grey

**PHOTOCHROMICS:**

Prescribe with caution in children with delayed light adaptation or dark adaptation.

**SENSORY SUBSTITUTION DEVICES**

The visually impaired can make use of other senses such as touch [tactile], hearing [auditory] and smell [olfactory] to substitute for the lack of vision. Any device that makes use of these other senses and devices the visually impaired is called a sensory substitution device. For example, Braille [tactile], audio books, etc.

**MEDICAL MANAGEMENT AND LIFE SKILL Devices**

Certain tasks are absolutely essential and necessary for daily living such as, currency
identification or loading an insulin syringe for diabetics. Devices that help with such tasks are called medical management and life skill devices. For example, pre set insulin syringe, Notex for currency identification, auditory liquid level indicators, thermometers, talking clocks, tactile mobile phone keypads, tactile/Braille keyboards.

**TECHNOLOGY IN LOW VISION MANAGEMENT**

1) **Using Computer**

1) For mild near visual acuity impairment (not accompanied by severe contrast sensitivity loss or severe field loss) - basic computer modification is usually sufficient
   - Lower the screen resolution
   - Set the computer to extra large fonts
   - Using high contrast desktop settings/themes
   - Change accessibility options to enlarge cursor size/icon size/scrollbar size/use high contrast settings
   - There are also modifications to customize the font color, background and font size for every component of Windows such as the Menu bar

2) For moderate to severe near visual acuity impairment: Screen magnifier software
   - This software split the screen into a magnified window (whose size can be altered) and the regular window
   - The magnified window can be set to suitable text size and color combination that is appropriate for the individual's acuity levels

3) These softwares also have audio features to read text when required

4) Individuals requiring upto 6x magnification (with the software) can generally function comfortably using this software. Beyond 6x, they tend to work easily with the audio function as the field of view is compromised beyond 6 Severe visual acuity loss: Screen reader software

5) Screen reader software provides an audio
output every time a key is pressed.

6) They have a wide variety of shortcut keys to enable easy use.

7) JAWS (Job Access With Speech Software by Freedom Scientific Inc) is the most commonly available software in India. It is also available with a voice having an Indian accent.

**READING SOFTWARE AND DEVICES**

- Various software with OCR (Optical Character Recognition) are available.
- These software use OCR technology to convert text on a scanned document to audio. (Example: Kurzweil, OpenBook)
- Stand alone devices that use OCR technology are also available. These devices have a camera that captures an image of text and reads text aloud. (Example: SARA Stand-Alone Reading Appliance, Freedom Scientific Inc, Intel Reader by Intel)

**SENSORY SUBSTITUTION DEVICES**

- Refreshable Braille Displays: These can be connected to a computer. The display then shows tactile dots on the screen that can be felt by the user. Some displays also have a braille keyboard attachment that can be used to input text. Bluetooth displays are also available that can be connected to mobile phones.

- Digital Book Reader Hardware/Software: Similar to music players, these devices convert electronic books into a DAISY format (Digital Accesible Information System). The books can be read in audio format and the user can toggle between chapters, pages, paragraphs or lines of text using buttons available on the player. (Example: BookSENSE, BuddyPlayer)

- Digital talking books are audio/visual books that can be magnified and read, or listened to depending on the user’s comfort.

- GPS devices: These devices use ultrasonic technology to detect objects/obstacles in the
path of the user (Example: Miniguide)
Bar-Code Readers: These devices help the individual identify items while shopping

**MOBILE PHONE TECHNOLOGY**

**Accessibility Settings**

**iPhone:** Larger dynamic type setting can be activated, invert colors and grayscale features are available, voice-over is a built-in screen reader. [Siri, Dictation, SpeakScreen and Zoom are other available inbuilt apps]

**Android:** Accessibility settings can be modified, Talkback is an in-built screen reader that will give an audio response to touch selection and gets activated with accessibility settings. Similar screen reader and screen magnifier software are available for use with mobile phones as also for laptops/computers (Example: Nuance talks and Nuance ZOOMS)

Other types of mobile phone apps:
- Big screen clocks
- Talking clocks
- Talking calculators
- GPS Based: Helps in navigation
- Obstacle detectors
- Magnifying cameras, use mobile phone camera to convert smartphone to portable CCTV
- Picture search: These compare a photo taken on a smartphone to images on the internet and help the user identify the object
- Organizer or Reminder Software: These can be just audio based or can connect to Braille displays
- Money Identifiers: To identify currency
- Color ID: To label colors

**ORIENTATION AND MOBILITY DEVICES**

Orientation is using the remaining senses to establish one's location in one's environment.

Mobility is an art of moving from one place to another independently, safely and gracefully. Mobility cane is the most commonly and widely used device in India.

Early intervention therapy in children – What is it?

Early intervention is defined by Stephens & Tauber (2001) in two parts, 'early refers to the most critical period of a child's development between birth and three years of age. Intervention refers to programme implementation designed to maintain or enhance the child's development in natural environments and as a member of a family' (Stephens & Tauber 2001).²

Infants with visual impairment face multiple problems:³
- Lack of communication with parents and subsequent insecurity for both parents and children
- Inhibited learning experience due to lack of visual stimuli
- Delayed mobility, speech and other milestones due to inability to see and learn

Early intervention services are aimed at infants with some amount of residual vision. They attempt to enhance visual milestones using a standardized approach called vision stimulation. The aim of vision stimulation³ is to attempt to aid visual development in children and provide training in visual skills such as – fixation, localization, scanning, searching, and tracking.

The early intervention therapist also works with the family to modify the child's environment to provide information that can be visually processed by the child. Further, the parents are taught various methods to interact with the child and aid further learning.

It is believed that provision of vision stimulation and early intervention therapy in infants with low vision can help in better utilization of vision when the child grows. However, early intervention is not a treatment aimed to improve the ocular condition. Early intervention therapy is also of benefit for children with total blindness:

The therapist works with the parent to teach them how to interact with the children and
- Provide sensory cues for interaction – such as touching and cuddling

Figure: Smart Cane
• Provide sensory cues for environmental interaction
• Enhance other senses
• Learn pre-cane skills – Pre cane skills can also be taught to preschoolers and children below the age of five. This helps them to learn to navigate the environment at a young age and prepares them to use the cane easily in the future

MANAGING FIELD LOSS

In general people with field loss have difficulty staying on a line or reading continuously due to skipping or mixing lines.

This can be managed by following compensating strategies:

**Single finger guide:** Thumb of left hand is placed at beginning of sentence and moved for each sentence.

**Double finger guide:** Thumb of left hand is placed at beginning of sentence while index finger of right hand is used to track the sentence. Left hand serves as guide to move back when the sentence is completed.

**Ruler:** Ruler is placed under the sentence being read (as if to underline)

**Typoscope:** Typoscope is used instead of ruler to track the line

CENTRAL FIELD LOSS

1) **Steady eye strategy**
2) **Eccentric viewing training**
   1) Subjectively
      i) Using Amsler grid
      ii) Using clock face
   2) Objectively:
      i) Scanning Laser Ophthalmoscope
      ii) Microperimeter

MANAGING PERIPHERAL FIELD LOSS

A visual field of less than 10 degrees requires the use of additional orientation and mobility techniques for mobility (Ferraro, J. and Jose, R. T. (1983).)
## Management - A Capsule

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SS- Sensory Substitution
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</table>
| Using keyboard      | Large print keyboard/
|                      | High contrast keyboard                     |                               |                    |                                             |                               |
|                     |                                             |                               |                    |                                             |                               |
|                     |                                             |                               |                    |                                             |                               |
| Touch typing (SS)   |                                             |                               |                    |                                             |                               |

SS - Sensory substitution

Note: All of the above management options are just commonly available management options which have been mentioned as a guideline.
MULTIDISCIPLINARY MODEL OF MANAGEMENT

Holistic management of the patient with low vision does not end with the Low Vision Care practitioner. Rehabilitation is the road to comprehensive management of the patient. The following is the basic skeleton of the multiple disciplines involved in management of the patient with low vision:

WHOM TO REFER AND WHERE

AT THE INFANT LEVEL

Special educators and rehabilitation therapists are important to provide vision stimulation and vision training so that the child may learn to use residual vision and develop various visual skills to maximum use of functional vision.

AT THE SCHOOL LEVEL

It is the special educator and the rehabilitation therapist who play the major role. Once the device has been prescribed by the optometrist and various guidelines have been suggested, the special educator and rehabilitation therapist are necessary for implementation of the suggestions and for helping the child cope with their sighted peers.

Modes of schooling available for children with low vision:
1. Regular education: Ordinary schooling with no specific modification except use of low vision devices if required.
2. Integrated Education: Ordinary school with additional special educator who gives child special classes or attention when required. No changes are made in daily classroom and class teacher has no special training to handle special needs.
3. Inclusive Education: Children of different types of disability in the same school or class. The class teacher is trained to handle children with special needs. Special concessions are made by the teacher to incorporate needs such as slow speed, use of special devices, using sensory substitution when child cannot use visual means.
4. Special education: Special school where all children have some form of visual impairment and sensory substitution is the primary method of teaching.

AT THE ADOLESCENT LEVEL

At this stage, the adolescent needs help from Career counselors, special educators, vocational trainers in order to decide the best vocation that will suit them for the future and acquire necessary skills for future career.

AT THE ADULT LEVEL

The most important role would be played by:
1) Rehabilitation therapist: For training in use of devices
2) Orientation and Mobility therapist: For independent mobility
3) Social worker: To help the individual and family cope with the onset of low vision

CASE REPORTS

Case 1

General History: A 14-year-old female diagnosed with high myopia and associated retinal finding of dry macula (Myopic Retinal Degeneration) was referred to the Low Vision Care Clinic as she had discontinued school three months back. She was accompanied by her parents. There was no family history of parental consanguinity. Her younger sister had myopia [around -3.00D and no visual impairment]. There was no other relevant history. Previous Low Vision Care: Nil

Present Complaints

Distance visual tasks: The patient had difficulty seeing the blackboard and recognizing the faces of people who were more than three metres away. She watched television from a distance of one metre.

Near visual tasks: The patient was able to manage at a close working distance of around 15 centimeters.

ADL/Mobility: These tasks were independent.

Light Sensitivity: There were no complaints regarding light sensitivity.

Additional History: Classroom environment

School: Private school (English medium), State Board of Education syllabus

Medium of Teaching: English
Class Strength: 30
Academic performance of patient: Average (50-60%)
Reason for discontinuing school: Unable to see blackboard from front bench at a distance of three meters.
Parents say teacher wrote letters of size about one finger length (~2.5 inches or 6-7 cms)
Color of board: Black
Letters: White chalk used, Colored chalk: rare
Class lighting: Sufficient (no glare and no complaints of dim/poor lighting, including cloudy days)
Internal lighting present in class: three fluorescent lights
External Lighting: three large windows
Seating position: Third row, center
(No flexibility in seating, not allowed to copy or reference friends’ notebook)
Visual requirements: Seeing blackboard
Examination:
Previous Glass Prescription:
OD: -13.50 DS / -2.00C x 50
OS: -12.00 DS/ -1.25 DC X 45
Distance visual acuity with glasses
OD: 3/3012, 6/6012
OS: 3/19, 6/38
B/O: 3/19, 6/38
Near visual acuity with glasses: OD/OS/B/O: N8 @ 15 cm
Reading Speed: 40 wpm
Unaided near visual acuity: B/O: N5 @ 10 cm
Reading speed: 60 wpm
Refraction
Retinoscopy:
OD: -11.50DS/-1.00 DC X 60
OS: -11.25 DS/-1.25 DC X 120
Dynamic Retinoscopy: (MEM)
Accommodative Lag: +1.00 DS to +1.25DS
Subjective Refraction
OD: -11.50DS/-1.00 DC X 60 [3/9.5 , 6/19]
OS: -11.25 DS/-1.25 DC X 120 [3/9.5 , 6/19]
ADD: OU: Does not prefer ADD
Unaided near visual acuity: N5 with ease @ 10 cms

Low Contrast Visual Acuity: 3/19 [6/38] → Borderline impairment
D15: Normal
Amsler: No scotoma detected
Confrontation: Normal peripheral fields
LVD Trial for distance
Required visual acuity: 6/6
Magnification required: = 3X
Trial 1: 3x Monocular Handheld Telescope: 6/6 with ease
Telescope training was given – Able to localize, hold fixation, scan, track and copy from text on sample blackboard.
Copies text at speed of 30-40 wpm.
LVD Trial for near: Reads up to N8 with correction
Reads up to N4 unaided
Trial 1: Add +1.00DS to +5.00DS tried in 1.00D steps. Patient does not report significant difference/improvement
Trial 2: With 4x Dome Magnifier: N4; Reads with ease @ 40 cms Reading speed: 80 wpm
Discussion: High myopia is associated with various complications such as retinal holes, retinal detachment open angle glaucoma and macular degeneration1. Myopic macular degeneration does not result in blindness with prognosis being loss of visual acuity up to 3/60.2
Another problem for subjects with high myopia irrespective of other complications is close working distance for near. The close working distance devices in seeing finer details3 and in improving retinal image quality.4 Low vision correction is appropriate in high myopia5 when an increase in working distance is desired. In this case, magnification was prescribed keeping in mind that accommodative demand had to be reduced. This is because it has been shown that increased accommodative lag and near induced transient myopia can further cause progression of myopia.6 Further, the use of magnification would improve retinal image quality thereby reducing strain, especially where it would be necessary to see finer details.
Final Rx
1. New Rx for distance
2. 3x Monocular handheld telescope for use with blackboard
3. To use dome magnifier for prolonged reading tasks, to reduce eyestrain, reference atlas, maps, dictionaries or fine print
4. To use reading stand for prolonged reading tasks to aid posture and maintain working distance

Other Advice: The condition and prognosis were clearly explained to the parents. The parents were reassured about closer working distance and the need to use a magnifier for comfortable reading at close working distance was explained. The child was advised to continue her schooling with the help of low vision care. They were also counseled about available options for computer modification and magnification.

References

Case 2
General History: An eight-year-old female diagnosed with congenital stationary night blindness was accompanied by her parents to the low vision care clinic. Her difficulty with dimly lit environment was noticed by the parents at around one year of age. She was staying with her parents and two elder brothers. At the time she was studying in Std II. Her parents did not have a consanguineous marriage but her mother's age was around 34 when the child was born. Her father who was working in an automobile assembly company was the source of family income.

Previous History: She had no history of using any low vision devices.
External observation showed she had good fixation but difficulty in searching for a pen among various items placed on the table.

Present Complaints:
Distance Visual Tasks: Difficulty with seeing the blackboard in the classroom (three Meters), seeing objects at distance while sightseeing. She was able to manage all near acuity tasks at a closer working distance.

Mobility and ADL: She was able to move around independently but had difficulty in dim light and took long time to adjust to dimly lit surroundings. She had independent activities of daily living within the limitations of her age.

Additional History: Classroom environment:
- Seated at three meters from blackboard
- Use of white chalk. Colored chalk used occasionally
- Allowed to come close to the board
- No note-taking until class IV in the school
- Artificial room lighting – five fluorescent lights
- Class strength: 40 students
- Medium of instruction: English
- Type of school: Private
- Syllabus: State board

Patient requirement: Seeing blackboard.

Examination

Visual Acuity
Distance Visual Acuity with Bailey Lovie LogMAR chart:
OD/OS/B/o: 3/12 [6/24]
Near visual acuity: N10 @25 centimeters with the
MN Read chart at 10 wpm good reading skills
There was no difference between monocular and binocular visual acuities. There was no significant refractive error on objective refraction.

**Dynamic Retinoscopy:** Accommodative lag: +1.00DS

**Cycloplegic refraction:** No refractive error requiring correction detected.

Low contrast visual acuity with Bailey Lovie Low Contrast LogMAR chart was 3/15[6/30] (Within normal limits).

**Color Vision:** Able to match a few colors on the D15 panel but could not comprehend the entire test.

**Confrontation:** Mild peripheral field deficit beyond 50 degree visual field.

**Trial of Low Vision Devices**
1. 4x monocular handheld telescope: 6/6 [no specific preference for right or left eye]

**Near**
ADD: OD/OS: +2.00DS: N4 @ 20cm

The child seemed to be able to read better and reading speed improved to 25 wpm for finer print (>N10 size)

**Discussion**
Congenital stationary night blindness is considered to have an X-linked pattern of inheritance. The prevalence of the condition is not known. It is characterized by non-progressive defective dark adaptation, myopia and associated nystagmus or strabismus in some cases. The visual acuity ranges from 6/9 to 6/60 and myopia from moderate[-0.25D to -4.75D] to high[>-10.00DS].

Binoculars are generally prescribed for children who have difficulty with focusing or have motor problems as the weight and field of view of the binoculars makes it easier to handle for shorter periods of time. For this patient, binoculars were suggested in order to habituate the patient to the use of binoculars for comfortable distance viewing and to accustom the patient to the use of a low vision device for distance vision tasks. Prescription of Bifocal Rx with higher ADD need to be considered as the first choice for children with low vision, if they are too young to handle any low vision device.

**Final Rx**
New Bifocal Rx with +2.00DS ADD.

The parents were advised to purchase over the counter binoculars of 3x or more magnification. A letter was given to the school to provide a separate seating arrangement closer to the blackboard at less than two meters when required. (Currently, students were not required to copy any notes from the blackboard).

**Advice**
The child was advised to be seated in a separate chair (ahead of the front row) closer to board at ~2m. Letter was given to school management recommending closer seating arrangement, increased lighting level and compensatory time for completing her examinations. The parents were advised to increase the illumination level at home especially during night time. The child needs to be instructed on caution regarding mobility tasks. Option of low vision devices were explained to parents which will be beneficial in the future. The patient was advised to come for an annual low vision care visit with her school books and class notes.

**References**

Appendix - I

LOW-VISION ASSESSMENT WORKSHEET

START TIME:      AGE/SEX:
DATE:            PATIENT ACCOMPANIED BY:

OPTOMETRIST:
CONTACT DETAILS:
DIAGNOSIS:

ONSET OF DIFFICULTY WITH VISUAL TASKS

[CONDITION: IMPROVING/FLUCTUATING/WORSENING/STABLE]
FAMILY HISTORY:
PARENTAL CONSANGUINITY:  YES / NO
OCULAR DISEASES:  YES / NO IF YES DETAILS:
OTHERS:
GENERAL HEALTH:
OTHER LIMITATIONS/DISABILITIES:  YES/NO
WALKING/TREMORS/HEARING LOSS/MULTIPLE DISABILITIES/DELAYED MILESTONES/OTHERS
EXTERNAL OBSERVATION:
EDUCATIONAL QUALIFICATION:
OCCUPATION:
LIVING SITUATION:
SOURCE OF FAMILY INCOME:
PREVIOUS LOW VISION CARE:  YES / NO IF YES, WHERE:
IF YES:
a) SELF PURCHASED
b) PRESCRIBED
C) PRESCRIBED BUT NOT BOUGHT
a) OPTICAL
DISTANCE: TELESCOPE : MONOCULAR / BINOCULARS / SPECTACLE MOUNTED/ SEE TV/OTHERS
MAGNIFICATION:
NEAR: HAND-HELD /POCKET/ STAND /SPECTACLE / DOME MAGNIFIER/ OTHERS
MAGNIFICATION:
b) NON- OPTICAL: NOTEX / TYPOSCOPE / READING LAMP / READING STAND/ NEEDLE THREADER
/ SIGNATURE GUIDE/ TORCH/ CAP/ SUNGLASSES/OTHERS
c) ASSISTIVE DEVICES / SOFTWARE:
USING PREVIOUS LVD’S SINCE HOW LONG:
USING PREVIOUS LVD’S FOR WHAT PURPOSE:
AVERAGE USING TIME PER DAY:
ANY DIFFICULTY WITH DEVICES: YES / NO
IF YES DIFFICULTY IN:
PRESENT COMPLAINTS
DIFFICULTY IN DISTANCE VISION: YES / NO IF YES,
SEEING BLACK BOARD / RECOGNIZING FACES / WATCHING T.V/
BUS NUMBERS / SHOP NUMBERS / SEEING TRAFFIC LIGHTS
SEEING STREET SIGNS / CROSSING ROADS / DRIVING / GETTING AROUND PEOPLE OR OBJECTS /
SEEING CURBS OR STEPS

OTHERS:
DIFFICULTY IN DISTANCE VISION: YES / NO IF YES,
SEEING BLACK BOARD / RECOGNIZING FACES / WATCHING T.V/
BUS NUMBERS / SHOP NUMBERS / SEEING TRAFFIC LIGHTS
SEEING STREET SIGNS / CROSSING ROADS / DRIVING / GETTING AROUND PEOPLE OR OBJECTS /
SEEING CURBS OR STEPS

OTHERS:
DIFFICULTY IN READING FOR NEAR: YES / NO / N.A
COLLEGE BOOKS / SCHOOL BOOKS / OFFICE BOOKS / REGULAR PRINT BOOKS / NEWS PAPER/
COMPUTER PRINT OUTS/ OFFICE RELATED MATERIALS /
CHEQUE BOOKS/ CHALLAN BOOKS/ RELIGIOUS BOOKS / PRICE TAGS / BILLS / MEDICINE LABELS /
EXPIRY DATE / TEXT IN MOBILE/ HAND WRITTEN MATERIAL/ MANAGING ACCOUNTS

OTHERS:
ARE YOU MORE COMFORTABLE /DOES DIFFICULTY REDUCE ON
TAKING READING MATERIAL CLOSER? YES/NO
READING IN INCREASED LIGHT? YES/NO
TO WHAT EXTENT READING IS A PRIORITY
ACADEMIC / EDUCATIONAL / OCCUPATIONAL / PLEASURE / INFORMATION/

OTHERS:
DIFFICULTY IN WRITING: YES / NO/ N.A
SEEING TEXT WRITTEN BY SELF/ WRITING ALONG A STRAIGHT LINE/
SIGNING CHEQUE BOOKS / SIGNING OFFICE PAPERS/ OTHERS
DIFFICULTY WORKING WITH COMPUTERS: YES / NO / N.A.
IF YES: SEEING KEYBOARD / FINDING OPTIONS ON SCREEN /
READING TEXT ON SCREEN/ CLOSE WORKING DISTANCE /
CONTRAST OF LETTERS/ GLARE – SCREEN IS TOO BRIGHT/OTHERS:
DIFFICULTY IN MOBILITY TASKS: YES/ NO

STAIRCASES / FAMILIAR PLACES / UNFAMILIAR PLACES/GETTING AROUND PEOPLE/
BUMPING INTO OBJECTS/ STEPS ON OBJECTS ON THE FLOOR/OTHERS
MANAGING BY: USING CANE / HAVE AN ASSISTANT OUTDOORS /RESTRICTED TO HOME /NIL

DIFFICULTY WITH: SUNLIGHT/BRIGHT LIGHT: YES / NO       DIM LIGHT: YES / NO
DELAYED ADAPTATION:       YES / NO       IF YES :LIGHT / DARK
DISABILITY/DISCOMFORT GLARE       YES / NO

DIFFICULTY WITH DAILY LIVING ACTIVITIES: YES / NO       IF YES DIFFICULTY IN:
GETTING DRESSED/ BUTTONING CLOTHES/ TYING SHOELACES/ PERSONAL HYGIENE / SEEING
FOOD ON TABLE/THREADING NEEDLE / STITCHING/ EMBROIDERY/ DOING HOUSE WORK / COOKING/CURRENCY IDENTIFICATION/ COLOR PERCEPTION / IDENTIFYING OBJECTS IN A GROUP/
GROPING FOR OBJECTS ON FLOOR

OTHERS:
AWARE ABOUT DISABILITY CERTIFICATE OR CONCESSION: YES / NO / N.A.
ALREADY AVAILING CONCESSIONS FOR DISABILITY: YES / NO / N.A.

ADDITIONAL HISTORY:
PATIENT’S VISUAL NEEDS / EXPECTATIONS:
PREVIOUS GLASS PRESCRIPTION:

Duration:
OD) ADD: OD:
OS) OS:
A. DISTANCE B. NEAR C. BIFOCALS D. ANY TINTS E. ANY
ADDITIONAL RX:
OCULAR EXAMINATION

DISTANCE VISION: (RX / U/A) LETTER ACUITY WITH PH:
OD:
OS:
B/O:

FIXATION: CENTRAL / ECCENTRIC CHART USED:
NEAR VISION: AIDED / UNAIDED WORKING DISTANCE CHART USED:
OD:
OS:
B/O:

NEAR VISION: AIDED / UNAIDED CHART USED:
OD:
OS:
B/O:

ILLUMINATION USED: 1. ROOM ILLUMINATION 2. INCANDESCENT 3. FLUORESCENT
RETINOSCOPY: OD:
OS:

ACCEPTANCE: OD:
OS:
B/O:

ADD: OD:
OS:
OU:

PREFERENCE: FOR DISTANCE: NEW GLASSES OWN GLASSES WITHOUT GLASSES
FOR NEAR: NEW GLASSES OWN GLASSES WITHOUT GLASSES

LOW CONTRAST VISUAL ACUITY [FACT/BAILEY LOVIE]:
OU:

COLOR VISION [WITH D-15 / ISHIHARA / ICHIKAWA]:
OU:

AMSLER (TESTING DISTANCE:)
OD)
OS)
OU)

CONFRONTATION: OD:
OS:
LOW VISION AID TRIAL

PREFERRED EYE (SUBJECTIVE) OD / OS / OU
TRIAL FOR DISTANCE: (OPTICAL): OD / OS / OU:
CURRENT VISUAL ACUITY: REQUIRED VISUAL ACUITY:
REQUIRED MAGNIFICATION:
PREFERENCE:

TRIAL FOR NEAR: OD / OS / OU:
CURRENT NEAR ACUITY: CURRENT WORKING DISTANCE:
REQUIRED NEAR ACUITY: REQUIRED MAGNIFICATION:
PREFERENCE: READING SPEED:

ILLUMINATION PREFERENCE:
1. ROOM ILLUMINATION 2. INCANDESCENT 3. FLUORESCENT

TEXT USED: TRIAL OF NON-OPTICAL DEVICES: DONE / NOT REQUIRED:
NOTEX / TYPOSCOPE / READING STAND / NEEDLE THREADER /SIGNATURE GUIDE/LETTER WRIT-ER
OTHERS:
TINTS: (TRIAL PERFORMED OUTDOORS / INDOORS / BOTH) DONE/NOT REQUIRED:
TRIAL:

PREFERRED TINT:
VISION:

COMPUTER SOFTWARE: DEMO GIVEN/ RECOMMENDED /NOT REQUIRED:
□ MAGIC □ JAWS □ OPEN BOOK □ KURZWEIL □ BIG-SHOT
□ ZOOMTEXT □ KINDLE □ TEXT ALOUD
□ CHANGE COMPUTER SETTINGS (RESOLUTION /CONTRAST)
□ MAGNIFIER SETTINGS (START MENU)
□ OTHERS:

MOBILE SOFTWARE: RECOMMENDED/NOT REQUIRED:
□ MOBILE SPEAK □ MOBILE MAGNIFIER □ TALKS □ ZOOM
□ OTHERS

OTHER REMARKS: / HANDWRITING SAMPLE:
CASE SUMMARY – Low Vision Care Clinic (LVC)

(Relevant Options Are Ticked)

BEST CORRECTED VISUAL ACUITY
DISTANCE: OD: ( ) OS: ( )
NEAR: OD: ( ) OS: ( )

COLOR VISION: □ Normal □ Protag defect □ Deutan defect □ Tritan defect
□ Non specific defect □ Deferred / Not tested

CONTRAST SENSITIVITY: □ Normal □ Impaired contrast sensitivity
□ Deferred / Not tested

VISUAL FIELDS: □ Normal □ Central scotomas
(AMSLER / CONFRONTATION) □ Peripherally constricted □ Distortions
□ Tubular fields / Temporal island of vision □ Deferred / Not tested

FINAL Rx

ADVICE:
Explained □ condition □ possible prognosis

CONTRAST ENHANCING MEASURES EXPLAINED
□ Increase task illumination – Fluorescent / Incandescent
□ Use black pens /8B pencils /10B pencils Felt tip pens
□ Use large black dial watches with white letters
□ Mark borders of staircases / doors / cupboards / switchboards with contrast colors
□ Paint kitchen counter with two contrasting colors.
□ Use contrasting cutlery – plates / tea cups.
□ Use contrasting colored equipment in bathrooms.

MEASURES FOR COLOR ENHANCEMENT EXPLAINED: □ NOT REQUIRED
□ Label pens / pencils □ Use patterns □ Mark clothes on inside with buttons/textures □ Others

MODIFICATIONS FOR ACTIVITIES OF DAILY LIVING EXPLAINED □ NOT REQUIRED
□ Chime clock □ Furniture arrangement □ Food arrangement
□ Kitchen arrangement □ Others

FOR MOBILITY TASKS □ NOT REQUIRED
□ Head scanning explained □ Eccentric viewing explained
□ Need for Orientation and Mobility Training explained □ Others

REFERRED FOR: □ NOT REQUIRED □ Orientation and Mobility training
□ Daily Living Skills □ Vocational guidance / Independent Living skills / Computer software training
□ Disability certificate □ Others:

MOBILE SOFTWARE:
COMPUTER SOFTWARE:
OTHER ADVICE:
OTHER SERVICES REQUIRED:
RTC TO LVC CLINIC: SIGNATURE
END TIME:
Appendix – I a

CLASS ROOM ENVIRONMENT

Standard: Informant:
Mode of education: a) Special school b) Regular school c) Private tutor
School name/ College name:
Class teacher / Principal name:
Address of the school/ college:
1. Class strength:
2. Seating position: Center / Corner
3. Approx distance from board:
4. Which bench / row:
5. Color of writing material on board:
6. Color of the board:
7. Number of windows in class:
8. Sitting beside window:
9. Amount of light in class: Dimly illuminated / Optimally illuminated / Glaring (too bright)

Academic performance:
Good peer-group interaction: Yes / No Good parent-teacher interaction: Yes / No
Is there any difficulty in copying from black board: Yes / No
If yes: managing by: Copying from friends / Going close to the black board / Taking friends note-books to home / Teacher's dictation.
Others:
Using extra hours for writing exams: Yes / No
Use of special assistance: Yes / No
If yes: Scribe / Braille / Talking books/ Audio cassettes
Others:
Since how long:
Any difficulty with special assistance:
Is the teacher co-operative and ready to give individual attention: Yes / No / NA:
Will the school management be ready to make changes in the setup: Yes / No / NA
Letter to the class teacher required: Yes / No / NA
TEST PERFORMED: OD/ OS/ OU

Array:
Impression: Normal Color Vision / Protan / Deutan / Tritan / Non Specific color defect

FACT recording sheet
LETTER TO SCHOOL MANAGEMENT

This is to state that Master/Miss.______________________________ who is studying________STD in your school (Reference MRD No.: _____________) was evaluated in the Low Vision Care Clinic. He was noted to have _____________ Visual Impairment in both the eyes due to retinal problem.

This vision will not be sufficient to view the black board comfortably. He needs to be seated closer to the black board (i.e, one meter distance) or in the front row (without rotation). Most of his learning will be through listening to the classes, so dictating as much as possible will help him in a large way.

Kindly allow him to copy notes from his friend's notebook in case he is not able to copy from the black board directly. In addition, he can be given compensatory time concession of minimum 30 minutes for all examinations (school level and for board exams)

[Source: F.No.16-110/2003-DD.III, Government of India, Ministry of Social Justice and Empowerment, New Delhi, India]

Please extend your co-operation so that his ocular condition doesn't interfere with his academic performance.

Thank you for your kind co-operation.

Yours sincerely

(__________)
Optometrist
Low Vision Care Clinic
Sankara Nethralaya
Chennai- Tamil Nadu
Phone: 044-42271519
APPENDIX – II b

LETTER FOR DISABILITY CERTIFICATE

LOW VISION CARE CLINIC

TO WHOMSOEVER IT MAY CONCERN

Date:

This is to state that Mr/Ms. ____________________ (Reference number:___________) was evaluated in the Low vision care clinic and was noted to have best corrected visual acuity of __________ in the right eye and ___________ in the left eye due to ___________.

He can be considered as ________% visually handicapped [Source: No. 16-18/96-N.I.I, Government of India, Ministry of Social Justice & Empowerment, New Delhi, India Category _______] and he is eligible for possible concessions and benefits according to this category.

Yours sincerely

(______________)

Optometrist

Low Vision Care Clinic

Sankara Nethralaya

Chennai- Tamil Nadu

Phone: 044-42271519

Appendix – III

Rehabilitation Center

Sample - Rehabilitation wise contacts

• Readers facility
• Blind School
• Early Intervention center
• For children with learning difficulty
• Special school
  – Integrated schools and Special educators
  – Inclusive school
  – Braille Training (Pre-school)
• Vocational Training
• Disability certificate - SRTC
  – Computer software training
  – Mobile software
  – Job placement
Appendix - IV

SOURCES OF LOW VISION & ASSISTIVE DEVICES

1. Karishma Enterprises
   132, Market Tower B, Cuffe Parade,
   Mumbai 400 005, India
   Phone: 022-22181853;
   Fax: 022-22153291
   Email: ke@vsnl.com
   Website: www.brailleworldindia.com

2. Barrier Break Technologies
   101, Highway Commercial Complex
   IB Patel Road, Goregoan (E),
   Mumbai- 400 063, India
   Phone: +91 (22) 2685 9730/ 2686 0485/6
   cell: +91 99202 29081
   E-mail: Vasu@barrierbreak.com
   Website: http://www.barrierbreak.com

3. Om Tao Scientific Apparatus
   3-2-320/2, Chappal Bazar Kachiguda
   Hyderabad - 500 027
   Tel: 9885054759
   Email: omtaosa@hotmail.com

4. JUTRON Vision
   A-6, Nand Complex,
   Near Aims Oxygen Juna Padra Road
   Baroda-390020
   Phone: +91 -99987-02020
   Fax: 91-265-2321323
   Email: mukul@jutronvision.com

5. ABISee, INC
   141 Parker St, Suite 201,
   Maynard MA 01754, USA
   Phone: 800-681-5909
   Website: www.abisee.com

6. Telesensory
   520 Almanor Avenue
   Sunnyvale, CA 94085, USA
   Website: www.telesensory.com
   Email: info@telesensory.com

7. Dolphin Computer Access Ltd.
   Technology House,
   Blackpole Estate West
   Worcester, WR3 8TJ
   United Kingdom
   Tel: +44 (0) 1905 754 577
   UK Local Rate
   (from a BT landline): 0845 130 5353
   Fax: +44 (0) 1905 754 559
   Email: info@dolphinuk.co.uk

8. Freedom Scientific
   11800 31st Court North
   St. Petersburg, FL 33716-1805, USA
   Phone: 1-727-803-8000 (worldwide)
   Fax: 1-727-803-80
   Web-site: www.freedomscientific.com
Appendix - V

Useful web links related to Low vision

1) For children with low vision http://www.lowvisionkids.com
2) Visual perception and tracking skills - http://www.eyecanlearn.com/#Peripheral
4) Punarbhava
   (National Interactive Portal that provides information for persons with disability)
5) National Initiative for the Blind (NIB) - Centre for computer training
   http://acharya.iitm.ac.in/projects/trgschools.php
6) International Council for Education of People with Visual Impairment
   (ICEVI) - Education for all children and youth with visual impairment
   http://www.icevi.org/
7) Information / links useful for patients - awareness
8) Cell phone accessibility for visually impaired
9) Computer softwares & Internet accessibility for the disabled screen magnifiers
   http://www.lowvision.org/access_to_the_internet.htm
   http://www.daisyindia.org/02HelloDAISY.html
   http://www.daisyindia.org/index.htm
10) National Association for Visually Handicapped (NAVH)
    Low vision services to assistive devices to support groups
    http://www.navh.org/about/accessibility.htm
11) Vocational training center
    http://www.dget.gov.in/mes/
12) Reading materials
13) Engineering books – Audio format
    www.samritatrust.org
14) Special schools for MR children
    • Statewise contacts
      http://www.udaan.org/parivaar/india.html
    • Countrywise contacts
      Ministry of social Justice: http://socialjustice.nic.in/policiesacts3.php
      To know about concessions given for person with multiple disabilities:
      http://www.fourstepsindia.org/index.html
      National Trust schemes:
      http://www.thenationaltrust.co.in/nt/index.php?option=com_
15) Link to National trust for special children - statewise contacts
   http://thenationaltrust.in/NewWeb/snaplist.mht
16) Eligibility of driving in India
   http://www.delhitrafficpolice.nic.in/old-age-and-driving.htm#q14
17) Braille press and other provisions for persons with multiple disabilities
   http://socialjustice.nic.in/brailpress.php
18) Job placement
   www.enable-india.org Enable India
   http://www.eyeway.org/include/cl-jobs.php Eyeway.org
   http://www.ncpedp.org/employ/placements/viewopenings.php NCPEDP
19) Information regarding available sources for all visually impaired (partially sighted, blind, etc)
   http://www.sightlosssolutions.org/
20) ROPARD is The Association for Retinopathy of Prematurity and Related Diseases – awareness link for parents
   http://www.ropard.org/information-for-parents?start=1
21) Link provides information especially for blinds
   http://www.hadley.edu/7_c_links.asp
22) Blind resource center for visually impaired and Blind
   http://www.nyise.org/speech/homepage.htm
23) Personal Web Sites of the Blind and Visually Impaired
   http://www.lowvision.org/personal_web_sites_of_the_blind_.htmlL
Reference:


8) [http://www.lea-est.fi/en/assessme/Pediatriclow_vis.html]

9) Hassan et al. What is the minimum field of view required for efficient navigation. Vision Res 2007; 47: 2115-2123

10) http://www.visionaware.org/info/everyday-living/essential-skills/an-introduction-to-orientation-and-mobility-skills/123


