Pediatric Eye Examination: An Overview

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Abstract

The comprehensive pediatric eye and vision examination helps in the evaluation of the structure, function, and health of the eyes and visual system. The parent/caregiver should accompany the child into the examination room for making the examination of a child easier. During the examination, information that is obtained is collated to explain symptoms reported by the patient and/or parent/caregiver and diagnose their cause. A comprehensive pediatric eye examination provides the means to identify the presence of other ocular or systemic conditions that may exist with or without symptoms.

Keywords: Childhood blindness, congenital cataract, examination under anesthesia, pediatric eye examination

History

Chief complaints

Whitish opacity, not able to visualize objects, failure to make eye-to-eye contact, wandering eye movements, poor school performance, and presence of squint or nystagmus have to be elicited. History of polyopia or diplopia has to be taken in elder children as this may be the presenting symptom in cases of subluxated lens.

Age of onset of symptoms

The earlier the age of onset of complaints, the more will be the amblyopia for diseases like cataracts/squint/ptosis or any other diseases resulting in stimulus deprivation. Patients with developmental cataracts and patients who develop squint at a later age have a better prognosis.

Duration of symptoms

The longer the duration of symptoms, the poorer the prognosis.

Laterality

Certain diseases such as persistent hyperplastic primary vitreous (PHPV) and coats' disease are more commonly unilateral. Diseases such as cataracts, congenital glaucoma, microspherophakia, and keratoconus are commonly bilateral. Prognosis is usually worse in unilateral cataracts when compared to bilateral cataracts due to late detection, development, and irreversible deprivation syndrome.

Association with nystagmus

The presence of nystagmus is suggestive of poor fixation and therefore poor visual prognosis.

In a patient with a squint, it is important to ask if the child freely alternates eyes or squint is present in one eye as this will affect the prognosis of the case. In patients with intermittent divergent squint, the duration of deviation of eyes through the day should be noted.

Antenatal history

Antenatal history regarding any rashes/fever during pregnancy is important to rule out toxoplasmosis, other diseases (syphilis and hepatitis B), rubella, cytomegalovirus, and herpes simplex (TORCH) infections.[1]

Natal history

It includes whether the child was born at full term/preterm, mode of delivery (normal vaginal delivery/lower-segment cesarean section), whether the child cried immediately after birth or not, the immunization status of the child, birth weight, any history of oxygen administration, and history of convulsions.

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Postnatal history

The history of neonatal intensive care unit stay is relevant.

Developmental history

It includes whether the child has attained the milestones as per his/her age or it was delayed. Delayed milestones can mean delayed visual development too. A history of delayed developmental milestones is suggestive of an underlying systemic disorder, and it makes contact lens or spectacle tolerance difficult thus impairing visual prognosis.

Family history includes history of consanguinity and history of ocular illness in parents or siblings.

Other history including history of any known allergy, any medication use, immunization status, and previous consults should be noted.

Systemic history including history of neuropsychological symptoms, history of seizures, and congenital abnormalities like cerebral palsy and Down syndrome needs to be elicited.

General Examination

A full-body examination should be done to rule out any association with a syndrome resulting or associated with the ocular complaints. Listed below are some common syndromes and their systemic features:

Features of Down syndrome include distinctive facial features, such as a small head, flattened face, short neck, protruding tongue, and palpebral fissures in the form of upward slanting eyelids.

Features of Marfan syndrome include a tall and slender build, disproportionately long arms, legs, and fingers, a breastbone that protrudes outward or dips inward, a high, arched palate and crowded teeth, an abnormally curved spine, and flat feet.

Ocular examination

To conduct a comprehensive examination of a child, the minimum required tools include a torch, a direct ophthalmoscope, and an indirect ophthalmoscope. It is ideal to assess the child when they are in a comfortable, awake, and alert state, especially for small children who can be positioned on their mother's lap or shoulder. Utilizing diffuse lighting is essential during the examination, as intense light can startle the child, making further evaluation challenging. To engage the child and maintain their cooperation during the examination, items such as toys, pictures, candies, mobile phones, or any captivating objects can be employed.

For a thorough assessment of the fundus and anterior segment, it is recommended to perform these examinations when the child is asleep or sedated. In specific cases, an examination under anesthesia may be required to achieve a comprehensive evaluation.

A comprehensive eye examination should include:

1. Visual acuity
2. Ocular motility and squint examination
3. Slit-lamp examination
4. Pupils
5. Intraocular pressure (IOP)
6. Cycloplegic refraction
7. Dilated fundus examination.

Visual acuity assessment

Both uniocular and binocular Visual acuity assessment is performed by age-appropriate vision screening methods.Vision screening stands as the foremost priority in pediatric eye examinations, yet it can pose a challenge when dealing with preverbal children. Ophthalmologists often resort to indirect methods for assessing vision in such cases. These indirect methods involve observing fixation patterns, pupillary light reflexes, and the child's general response to their surroundings. Fixation reflex typically emerges shortly after birth in most infants and becomes established in all by the age of 3 months. When a child demonstrates central, steady, and sustained fixation with the ability to freely alternate between both eyes, it suggests good and equal vision in both eyes. Conversely, if a child exhibits a preference for fixing with one eye or resists occluding one eye, it implies that the fellow eye may have poor vision. In infants, the Bruckner test, optokinetic nystagmus [optokinetic drum; Figure 1], cover test, Tellers Acuity Cards [Figure 2], and preferential looking test are useful methods of assessing visual acuity. Between the age group of 1 and 2 years, Worth's ivory ball test [Figure 3], screening test for young children, Retarded test [Figure 4], and Cardiff Acuity Cards [Figure 5] are used. LEA Symbols® Test [Figure 6] is useful in the age group between 2 and 3 years. Allen's picture cards [Figure 7] and Lippman's HOTV test are used in children aged 3–5 years. In older children over 5 years, Tumbling E, Landolt's broken ring, Snellen's chart [Figure 8], and logMAR visual acuity testing [Figure 9] methods are used to document visual acuity.

- External examination should include looking for head posture and oculofacial anomalies. Torch light examination of the external ocular structures should be done, such as the lids, lacrimal system, cornea, conjunctiva, sclera, and iris. Head posture can be best assessed by observing a child while he/she is interacting with parents
- Ocular motility can be assessed using objects or toys that will grab a child's attention. The Hirschberg test or a cover

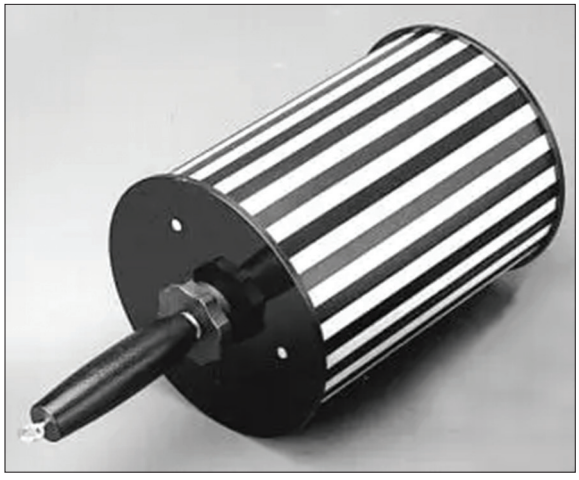

Figure 1: Optokinetic drum

Figure 2: Teller Acuity Cards

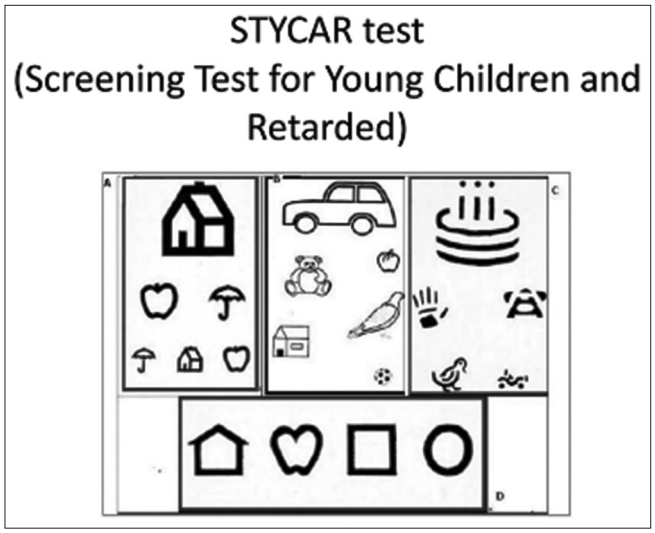

Figure 4: Screening test for young children and retarded test

test should be performed in suspected cases of ocular misalignment. It is important to differentiate pseudostrabismus from true strabismus. The presence or absence of nystagmus should be noted as this is an indicator of poor vision possibly due to some congenital ocular pathology

- The pupillary examination is a must and should include an assessment of size, shape, color of the iris, pupillary reactions (direct and consensual light reflex and relative afferent pupillary defect [RAPD]), and inter-eye asymmetry in pupil size. Abnormal pupillary reflexes or asymmetry in pupil size may be suggestive of an underlying central nervous system or ocular pathology, thus necessitating urgent imaging and referral to the neurologist. The presence of RAPD implies a posterior segment pathology. Abnormal pupillary reflexes or asymmetry in pupil size may be suggestive of an underlying central nervous system or ocular pathology. The abnormal shape of the pupil is suggestive of underlying ocular pathology. For example, a keyhole pupil in iridofundal coloboma. In cases of cataracts, maximum pupillary dilatation should be checked

Figure 3: Worth's ivory ball test

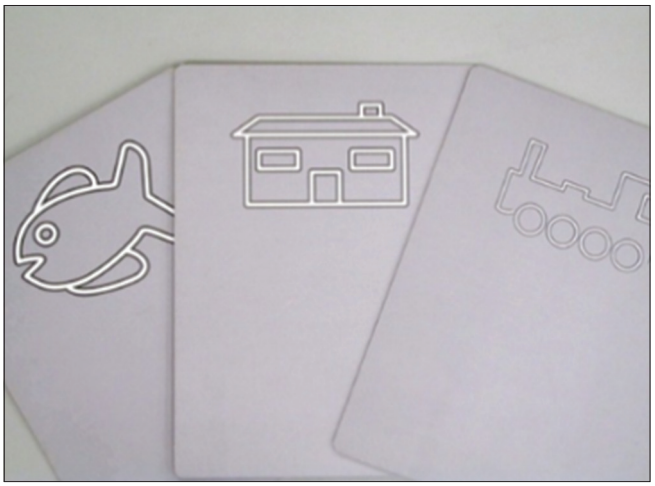

Figure 5: Cardiff Acuity Test

- Ocular motility and squint examination: Strabismus and nystagmus should be specifically looked for. Strabismus examination involves the Hirschberg test, cover uncover test, alternate cover test, and extraocular muscle movements. The degree of squint and fixation patterns (central, steady, maintained, or not) has to be checked. Central fixation suggests that the fovea is the fixing point. A steady fixation suggests that there is no component of nystagmus, and a fixation that is maintained suggests that there is no squint or that the eye has a reasonably good visual acuity. Strabismus can be seen in children when they have poor vision in one eye due to any cause. In patients with cataracts, the presence of either strabismus or nystagmus indicates that the cataract is visually significant
- Lacrimal apparatus examination: Regurgitation on pressure over the lacrimal sac area has to be carried out in all cases to rule out nasolacrimal duct obstruction
- Red reflex (Bruckner's reflex) should be assessed by distance direct ophthalmoscopy in a darkened room or in ambient light. A markedly diminished reflex, absence of red reflex, or presence of a white or yellow reflex (leukocoria), or asymmetry of the red reflexes is abnormal and indicates some underlying pathologies.[2] A markedly diminished

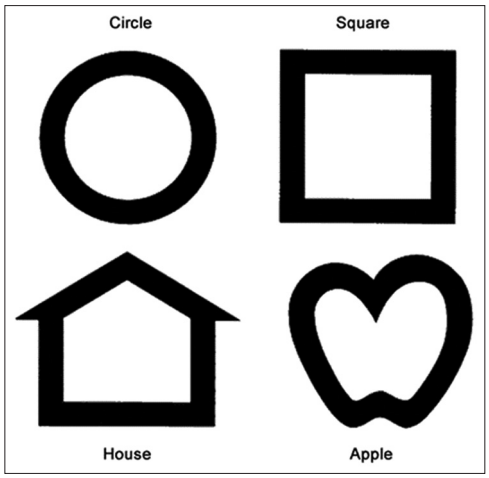

Figure 6: LEA Symbols Test

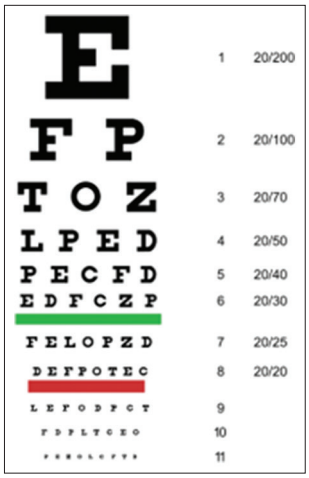

Figure 8: Snellen chart

reflex, absence of red reflex, or presence of a white or yellow reflex (leukocoria), or asymmetry of the red reflexes, is abnormal and indicates some underlying pathologies. Causes of leukocoria include:

- Abnormalities in the cornea (corneal opacity)
- Vitreous causes (vitreous hemorrhage and PHPV)
- Retinal diseases (Coats' disease, retinoblastoma, familial exudative vitreoretinopathy, retinal detachment, retinopathy of prematurity [ROP], and coloboma)
- Tumors such as medulloepithelioma and retinal astrocytoma.

Distant direct ophthalmoscopy is a very useful bedside technique of pediatric eye examination as it provides a lot of clinically relevant information regarding media opacities, media clarity, assessment of a visually significant pediatric cataract, and posterior capsular opacification requiring surgery.

- Detailed ocular examination should be performed by slit-lamp biomicroscopy (whenever applicable and possible). Slit-lamp biomicroscopy is useful to assess lens and cataract morphology in cases of congenital/developmental cataracts (zonular, blue dot, lenticonus, and polar cataracts). If the child is unable to sit at the slip lamp, a direct ophthalmoscope should be used to asses details as much as possible. When a child is not cooperative for slit-lamp examination, an examination under general anesthesia should be done. However, the same will not be possible in the examination by the resident but can be mentioned during viva
- Examination of the cornea: The following points have to be noted:
  1. Microcornea (Nance–Horan syndrome)
  2. Increased corneal diameter may be seen in megalocornea or buphthalmos
  3. Central corneal opacity (Peters' anomaly and Alport syndrome)
  4. Haab's striae (congenital glaucoma)
  5. Posterior embryotoxon (Peters' anomaly)
  6. Perforation and scarring (traumatic cataract).
- Examination of the anterior chamber
  1. AC depth
  2. Cells or flare (uveitic cataract)
  3. Presence of hyphema (posttrauma or in cases of juvenile xanthogranuloma)
  4. Presence of hypopyon (seen in cases of endophthalmitis, corneal ulcers, or some cases of retinoblastoma)
  5. Neovascularization of the iris

Figure 7: Allen's picture cards

Figure 9: LogMAR chart

6. Presence of vitreous in AC (traumatic cataract).

- Examination of the Iris
  1. Iridodonesis can be seen in cases of subluxated lens or aphakia
  2. Posterior synechiae (seen in cases of trauma or uveitis)
  3. Iris dystrophy (TORCH infection)
  4. Iridohyaloid blood vessels (persistent fetal vasculature [PFV])
  5. Aniridia
  6. Persistent pupillary membrane.
- Examination of the lens
  1. Morphology of cataract
  2. Subluxation/dislocation
  3. Phacodonesis
  4. Microspherophakia (Weill–Marchesani syndrome).
- Examination of the posterior capsule
  1. Capsule PC tear (traumatic cataract)
  2. Preexisting posterior capsular defect (PFV, lenticonus, lentiglobus, and posterior polar cataract)
  3. Posterior capsular calcification.
- A dilated fundus examination should be done for every child to evaluate the posterior segment. It is usually done with the help of an Indirect Ophthalmoscope. If the child is not cooperative for examination, retractors can be used after putting a drop of proparacaine in both eyes. Retinal anomalies in primary care practice include a swollen optic disc, which may be physiological or pathological swelling. The optic nerve drusen gives a swollen appearance to the optic disc (pseudopapilledema). Tilted disc and situs inversus usually occur in patients with high myopia. Bergmeister's papilla consists of remnants of hyaloid vessels and glial supporting structures and can be confused with raised neural tissue on the nerve head. "Choked disc" may be caused by papilloedema, which is due to a passive swelling of the optic nerve head or papillitis-active inflammation of the optic nerve head. Due to the similar ophthalmoscopic appearance of the two entities, investigations provide a definite diagnosis. Vision will usually be normal in papilledema. Peripheral and other retinal conditions include choroidal nevus, congenital hypertrophy of the retinal pigment epithelium, coloboma, Toxocara, toxoplasma chorioretinitis, and an operculated tear. All these conditions need to be identified after a comprehensive examination of the retina using scleral indentation wherever indicated
- Age-appropriate cycloplegic refraction using retinoscopy should be performed in all cases. The refractive error beyond 4D of myopia, 5D of hyperopia, and 2D of astigmatism can lead to amblyopia. Spherophakia and developmental cataracts can present with progressively increasing myopia. Subluxation can present with high hyperopia if the lens is shifted away from the pupillary area and the child is essentially aphakic. If one eye is pseudophakic, then the refractive status can help in the calculation of IOP power for the other eye
- Stereoacuity assessment (optional) may be done at least once in cooperative patients[3,4]
- Assessing IOP is not required in children unless glaucoma is suspected (e.g., presence of buphthalmos, epiphora, photosensitivity, and corneal clouding) or steroid therapy is given. Depending on the age and cooperation of a child, it may be done using the noncontact tonometer or rebound tonometer or under sedation/anesthesia with the help of a Perkins tonometer or Tono-Pen.[5] Applanation tonometry can be done if the patient is cooperative. Digital tensions have to be taken if the child is not cooperative. IOP can be raised in cases of traumatic cataracts. IOP also needs to be assessed to rule out congenital glaucoma
- Examination under anesthesia (EUA): This type of examination is required for younger children who cannot be seen at the slip lamp or are uncooperative for examination. EUA allows for detailed eye examinations and allows doctors to perform investigations. EUA is commonly done:
- For congenital glaucoma, the following parameters are evaluated
  1. IOP measurement using the Schiotz tonometer and Perkins tonometer
  2. Retinoscopy for refraction
  3. Corneal diameter using calipers
  4. Central corneal thickness measurement by pachymetry
  5. Axial length (AL) measurement using A-scan
  6. Direct gonioscopy using Koeppe lens or Swan–Jacob lens
  7. Indirect/direct ophthalmoscopy for optic disc evaluation and complete fundus examination
  8. Microscopic examination for corneal opacities, Haab's striae, or breaks in Descemet's membrane
  9. In children, postglaucoma surgery attention should be paid to bleb health, tube position, corneal clarity, and myopic shift.
- In trauma/chemical injury cases, staining of the cornea and conjunctiva (ocular surface) can be done using a sterilized 0.1% sodium fluorescein strip to look for associated epithelial defects. Eversion of the lids, including double eversion of the upper lid must be done in cases of suspected foreign bodies or chemical injuries[6]

Other indications include examination for anterior segment dysgenesis, congenital corneal opacities, retinoblastoma, and posterior segment examination, including dilated fundus evaluation (children with high myopia for peripheral retinal degenerations/treatment of retinal holes/lattices/ROP using laser indirect ophthalmoscopy) and other ocular tumors.

- Ocular investigations.

Ultrasonography B-scan: Rule out posterior segment pathologies such as retinal detachment, fundal coloboma, and retinoblastoma in case of traumatic cataracts to rule out intraocular foreign body.

Ultrasound biomicroscopy: Noninvasive imaging technique that helps in identifying anterior PFV, posterior capsular

Table 1: Age-appropriate methods for pediatric vision screening and criteria for referral

Method	Indications for referral	Recommended Age					
		Newborn-6 months	6-12 months	1-3 years	3-4 years	4-5 years	Every 1-2 years after age 5 years
Red reflex test	Absent, white, dull, opacified, or asymmetric	•	•	•	•	•	•
External inspection	Structural abnormality (e.g., ptosis)	•	•	•	•	•	•
Pupillary examination	Irregular shape, unequal size, poor or unequal reaction to light	•	•	•	•	•	•
Fix and follow	Failure to fix and follow	Cooperative infant ≥3 months	•	•			
Corneal light reflection	Asymmetric or displaced		•	•	•	•	•
Instrument based screening	Failure to meet screening criteria			•	•	•	•
Cover test	Refixation movement				•	•	•
Distance visual acuity (monocular)	Worse than 20/50 either eye or 2 lines of differences between the eyes				•	•	•
	Worse than 20/40 either eye					•	•
	Worse than 3 of 5 optotypes on 20/30 line, or 2 lines of difference between the eyes						•

Source: Hagan JF, Duncan PM, eds. 2017, Bright Futures: Guidelines for Health Supervision of Infants, Children and Adolescents. 4th ed.. Elk Grove Village, IL: American Academy of Pediatrics; 2017

defect, and posterior polar cataract preoperatively. Pediatric cataract is a common PG case given, and detailed information regarding biometry is a must. The following investigations are carried out.

Keratometry

It is done using handheld keratometers or automated keratometers.

In the case of an uncooperative child, standard K values of 43.00 D can be used; K values steeply reduce in the first 6 months (−0.40 D/month), −0.14 D/month in the next 6 months, and −0.08 D/month in the 2nd year, reaching the adult range at about 3 years of age.

Axial length

AL measurement is better estimated with immersion A-scan than indentation A-scan. Predicting AL growth and hence the myopic shift is difficult after pediatric cataract surgery. AL increases rapidly in the first 6 months (0.46 mm/month), then has a relatively slower (infantile phase) growth (0.15 mm/month) till 18 months, followed by a slow (juvenile phase) growth (0.10 mm/month).

Intraocular lens power calculation

Intraocular lens (IOL) can be implanted in eyes with Axial Length >17 mm and corneal diameter >10 mm. The initial desired refractive outcome after IOL implantation is moderate hypermetropia to avoid an undesired myopic shift in adulthood. Dahan and Drusedau suggested an undercorrection of 20% in children <2 years and 10% in children between 2 and 8 years. Enyedi suggested postoperative target refraction to be used for IOL power calculation according to age (age + postoperative refraction = 7). SRK/T and the Holladay 2 formulae have been shown to have the least predictive error.

Table 2: Guidelines for vision screening and comprehensive eye examination in children

Age	Timing
Neonates high-risk cases (premature, low birth weight, and Down syndrome)	At discharge and at 1 month of age
Birth–3 years	Vision screening by an ophthalmologist at least once
3–5 years	Comprehensive eye examination by an ophthalmologist at least once
5–8 years	Comprehensive eye examination by an ophthalmologist at least once

For a comprehensive pediatric eye examination at a specialized facility, various indications for referral to a pediatric ophthalmologist are summarized in Table 1.[7]

Age-appropriate methods for pediatric vision screening and criteria for referral (Table 1) are adapted from the American Academy of Ophthalmology Preferred Practice Patterns 2017.[7]

Timing of examination and screening

Pediatric vision screening and eye examination should be timed to maximize the detection of ocular morbidities and be able to provide timely intervention. Table 2 gives the guidelines for vision screening and comprehensive eye examination in children.

Guidelines for vision screening and comprehensive eye examination in children are adapted from the National Consensus Statement regarding pediatric eye examination, refraction, and amblyopia management.[8]

Special examination/tests

Color vision

Color vision screening is not mandatory; however, given an opportunity, it should be done in children at least once during their school years.

Visual fields

Routine visual field testing is typically not necessary. In the case of suspected visual field defects in children, confrontation visual field testing can be conducted. To assess the peripheral visual field in younger children, one can observe their response to the presentation of an object of interest in a specific gaze direction. If possible, the visual fields of children should be assessed with the method that is recommended for adults, i.e., automated static perimetry. For children who are too young to be tested with standard adult perimetry procedures, there are no widely available, quantitative perimetry techniques and, therefore, no standardized methods for evaluating disability related to restricted visual fields.[9]

Imaging

Imaging in the pediatric age group is indicated only in certain special situations.

- Face photography helps to document and follow changes of facial or ocular structural abnormalities. They can be taken with a flash so that corneal reflexes are seen that can help to check for ocular alignment and differentiate pseudo from true strabismus
- Family album tomography scan of old photographs may demonstrate a preexisting anomalous head or face tilting or turning that might reflect underlying well-controlled strabismus
- Anterior segment photography through a slit lamp for cataracts and other anomalies
- Corneal topography to detect early changes related to keratoconus
- Fundus photography may be needed for ROP screening and evaluation of torsion
- Fundus photography can be done to assess objective ocular torsion[10]
- Smartphone photography is a type of noncontact fundus photography. Newer generation smartphones are equipped with a high-quality optical system and a coaxial light source, which can be used to capture high-quality retinal images. The camera's coaxial flashlight and a handheld high-plus power lens create an indirect ophthalmoscopy-like optical system that is able to record high-resolution digital retinal images. The quick data transfer capability in smartphones can be utilized as an effective telemedicine tool to share and discuss cases in remote places, for example, screening for pediatric eye diseases such as ROP and diabetic retinopathy in children and adolescents[11]
- Rarely, optical coherence tomography (OCT)-based image analysis may be needed for optic nerve head assessment or abnormal retinal pathology
- One limitation to the widespread use of retinal nerve fiber layer measurements in pediatric patients is the lack of a normative database that can be used for comparison, as the databases currently in use represent only white patients of at least 18 years of age
- Flying baby spectral-domain-OCT provided a rapid and widely accessible imaging approach that overruled clinical findings and altered the classification and management of infants with advanced ROP. The methodology was suitable for outpatient settings with no risks associated with systemic anesthesia [Figure 10][12]
- Fundus fluorescein angiography (FFA): FFA is useful in other pediatric retinal diseases such as retinopathy in type 1 diabetes, incontinentia pigmenti, Familial Exudative Vitreoretinopathy (FEVR), dyskeratosis congenital, and muscular dystrophy, which have a common presentation of peripheral retinal avascularity, progressive neovascularization, and early development of tractional retinal detachment. In Coats' disease, FFA documents occurrence/progression of characteristic early telangiectasia, capillary nonperfusion areas, and leakage leading to subretinal exudation – all of which are difficult to detect and assess on indirect ophthalmoscopy.

Figure 10: Flying baby Heidelberg Spectralis spectral-domain optical coherence tomography. Images were acquired with the infant held in the "flying baby" position with the lid speculum under topical anesthesia only. The head was stabilized by gripping the angles of the mandible and additional support to the arms, and back was provided by an assistant

Visual Evoked Response

The visual evoked response (VER) is a valuable tool for vision screening in infants and children facing developmental delays, but its interpretation requires careful consideration. Typically, this test is administered after sedation, involving the use of flash stimuli through VER goggles. It is particularly beneficial when dealing with cases

Table 3: Various drugs used for inducing cycloplegia in children

Name of drug	Age indicated	Dose of instillation	Ocular side effects[19]	Systemic side effects[19]
Atropine sulfate (1% ointment)	<5 years	TDS 3 days*	Lid contact dermatitis, allergic conjunctivitis, and keratitis	Dryness of secretions, fever, skin rash, irritability, tachycardia, and convulsions
Homatropine hydrobromide (2% drops)	5–8 years	One drop every 10 min for 3–4 times	Similar to atropine but less severe	
Cyclopentolate hydrochloride (1% drops)	8–20 years	One drop every 15 min for 3 times	Tearing, allergic blepharoconjunctivitis, conjunctival redness, and increased intraocular pressure	Irritability, drowsiness, ataxia, disorientation, incoherent speech, restlessness, and visual hallucinations
Tropicamide (1% drops)	Primarily a cycloplegic agent with a mydriatic action	One drop every 15 min		Allergic reactions, drowsiness, and irritation
Phenylephrine (5%, 10% drops)	Only used as mydriatic alone or in combination with tropicamide. Concentration reduced to half (2.5%) in neonates and young infants	One drop every 15 min for 3–4 times		Systemic hypertension and tachycardia if applied at 10% concentration or higher dosages

TDS: Ter die sumendum

Table 4: Guidelines for refractive correction in infants and young children

	Refractive errors (dioptres)			
Condition	**Age <1 year**	**Age 1 to <2 years**	**Age 2 to <3 years**	**Age 3 to <4 years**
Isometropia (similar refractive error in both eyes)				
Myopia	5.00 or more	4.00 or more	3.00 or more	2.50 or more
Hyperopia (no manifest deviation)	6.00 or more	5.00 or more	4.50 or more	3.50 or more
Hyperopia with esotropia	2.00 or more	2.00 or more	1.50 or more	1.50 or more
Astigmatism	3.00 or more	2.50 or more	2.00 or more	1.50 or more
Anisometropia (without strabismus)				
Myopia	4.00 or more	3.00 or more	3.00 or more	2.50 or more
Hyperopia	2.50 or more	2.00 or more	1.50 or more	1.50 or more
Astigmatism	2.50 or more	2.00 or more	2.00 or more	1.50 or more

that present normal ocular findings but raise suspicions of cortical visual impairment. However, it is important to note that VER testing is not widely accessible and cannot be regarded as a standard component of a comprehensive pediatric eye examination.[13]

Pediatric refraction

Pediatric refraction is challenging since children have strong accommodation, are often uncooperative, and have a dynamic ocular system due to growth.[14]

Timing of refraction

It is recommended that all children undergo a vision assessment, including refractive testing if there are concerns about subnormal vision during preschool years, typically around the age of 3–4 before starting formal schooling. Early refraction evaluation is essential in cases where symptoms such as difficulty recognizing faces from a distance, a history of frequent falls, close-up activities like watching television or mobile devices, or specific clinical conditions are present. These clinical conditions may include a history of ocular surgery, especially for congenital cataracts, premature birth, perinatal complications, developmental delays, strabismus, or a family history of significant refractive errors. Pediatricians should be aware of the importance of timely referrals to an ophthalmologist in such cases, as high refractive errors can potentially lead to conditions such as squint or amblyopia and have a negative impact on the child's normal growth and development.[15]

Method of refraction

The most reliable method for pediatric refraction is a thorough retinoscopy. Although there are handheld and portable autorefractors available nowadays, they can be useful only for initial screening purposes. However, their accuracy is often less reliable when dealing with toddlers and infants. When it comes to school-age children who can cooperate effectively, autorefractors can be employed, especially when combined with appropriate cycloplegia to ensure accurate results.[16] While noncycloplegic refraction may be used for screening purposes, it is not recommended for the final prescription due to the variability in refractive errors.[17] Cycloplegia, which involves temporarily paralyzing the eye's focusing muscles, is essential to obtain a more accurate and stable prescription.

Use of cycloplegia

Atropine, homatropine, and cyclopentolate are commonly used cycloplegic agents in pediatric eye care, and they are

sometimes used interchangeably. Studies conducted in Indian populations have revealed variations in the cycloplegic efficacy of these drugs, with atropine and cyclopentolate being the most potent, followed by homatropine.[18] It is crucial to ensure effective cycloplegia, which can be verified by performing dynamic retinoscopy, while the child focuses on distant and near objects to obtain a consistent measurement.

In cases of esotropia in children under 5 years of age, atropine is the preferred cycloplegic because it is necessary to neutralize the accommodative component of esotropia. The commonly used cycloplegic agents in the pediatric population are elaborated in Table 3.

Prescribing spectacles

There are different practices in different parts of the country about the minimum refractive error to be prescribed. Table 4 provides the guidelines for minimum refractive correction in infants and young children.

Guidelines for refractive correction in infants and young children are adapted from the American Academy of Ophthalmology Preferred Practice Patterns 2017.

Prescription in special conditions:

- Prescription in pseudophakic and aphakic patients: Refractive error as assessed by retinoscopy should be prescribed immediately irrespective of age in pseudophakic and aphakic patients. Glasses should be prescribed for intermediate vision in children up to 2 years, and thereafter with the added demand for distance and near vision, bifocals are to be prescribed. Occlusion/patching is needed in unilateral pseudophakia/aphakia or bilateral cases with unequal vision
- Gross developmental delay, Down syndrome, or mental retardation: Refraction and prescription according to retinoscopy should be given as early as 6 months of age
- ROP: Myopia tends to progress in cases of ROP, and prescription can be given according to retinoscopy as early as 6 months and repeated every 6 months
- Esotropia–hyperopia of ≥+1.5D must be prescribed in children with esotropia. Overcorrection is permissible as long as the vision stays above 6/12. Bifocals are needed in cases with a high AC/A ratio. Weaning of glasses should start at the age of 7 years depending on the retinoscopy but a close watch on esotropia is needed, and weaning is stopped or reversed if esotropia recurs with glasses on weaning.

Myopic children should be advised to reduce screen time and time spent on near activities (like reading) and increase outdoor activities.[20]

Follow-up of a case of refractive error

For children <3 years of age, refraction needs to be repeated at least once every 6 months, while for older children, it should be done on a yearly basis.

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Conflicts of interest

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References

1. Vijayalakshmi P, Kakkar G, Samprathi A, Banushree R. Ocular manifestations of congenital rubella syndrome in a developing country. Indian J Ophthalmol 2002;50:307-11.
2. Khokhar S, Pillay G, Agarwal E. Pediatric cataract – Importance of early detection and management. Indian J Pediatr 2018;85:209-16.
3. Hussaindeen JR, Rakshit A, Singh NK, George R, Swaminathan M, Kapur S, *et al.* Prevalence of non-strabismic anomalies of binocular vision in Tamil Nadu: Report 2 of BAND study. Clin Exp Optom 2017;100:642-8.
4. Hussaindeen JR, Rakshit A, Singh NK, Swaminathan M, George R, Kapur S, *et al.* The minimum test battery to screen for binocular vision anomalies: Report 3 of the BAND study. Clin Exp Optom 2018;101:281-7.
5. Jethani J. Using the rebound tonometer to measure intraocular pressure in an anesthetized patient. Indian J Ophthalmol 2014;62:832.
6. Dhillon HK, Agarkar S, Vijaya L, Bhende M, Baskaran M, Jaichandran VV. Examination under anesthesia: Preferred practice. Indian J Ophthalmol 2023;71:3438-45.
7. Wallace DK, Morse CL, Melia M, Sprunger DT, Repka MX, Lee KA, *et al.* Pediatric eye evaluations preferred practice pattern®: I. Vision screening in the primary care and community setting; II. Comprehensive ophthalmic examination. Ophthalmology 2018;125:P184-227.
8. Saxena R, Sharma P, Pediatric Ophthalmology Expert Group. National consensus statement regarding pediatric eye examination, refraction, and amblyopia management. Indian J Ophthalmol 2020;68:325-32.
9. RashtriyaBalSwasthyaKaryakarm. Guidelines for Universal Eye Screening in Newborns Including Retinopathy of Prematurity. Ministry of Health and Family Welfare, Government of India; 2017. p. 37. Available from: https://rbsk.gov.in/RBSKLive/
10. National Research Council (US) Committee on Disability Determination for Individuals with Visual Impairments; Lennie P, Van Hemel SB, editors. Visual Impairments: Determining Eligibility for Social Security Benefits. Washington (DC): National Academies Press (US); 2002. 4, ASSESSMENT OF VISION IN INFANTS AND CHILDREN. Available from: https://www.ncbi.nlm.nih.gov/books/NBK207548/
11. Khanna RK, Pasco J, Santallier M, Pisella PJ, Arsene S. Objective ocular torsion outcomes after unilateral horizontal rectus surgery in infantile esotropia. Graefes Arch Clin Exp Ophthalmol 2018;256:1783-8.
12. Agarwal K, Vinekar A, Chandra P, Padhi TR, Nayak S, Jayanna S, *et al.* Imaging the pediatric retina: An overview. Indian J Ophthalmol 2021;69:812-23.
13. Cehajic-Kapetanovic J, Xue K, Purohit R, Patel CK. Flying baby optical coherence tomography alters the staging and management of advanced retinopathy of prematurity. Acta Ophthalmol 2021;99:441-7.
14. Zheng X, Xu G, Zhang K, Liang R, Yan W, Tian P, *et al.* Assessment of human visual acuity using visual evoked potential: A review. Sensors (Basel) 2020;20:5542.
15. Monga S, Dave P. Spectacle prescription in children: Understanding practical approach of Indian ophthalmologists. Indian J Ophthalmol 2018;66:647-50.
16. Khurana R, Tibrewal S, Ganesh S, Tarkar R, Nguyen PT, Siddiqui Z, *et al.* Accuracy of noncycloplegic refraction performed at school screening camps. Indian J Ophthalmol 2018;66:806-11.
17. Guha S, Shah S, Shah K, Hurakadli P, Majee D, Gandhi S. A comparison of cycloplegic autorefraction and retinoscopy in Indian children. Clin Exp Optom 2017;100:73-8.
18. Khurana AK, Ahluwalia BK, Rajan C. Status of cyclopentolate as a cycloplegic in children: A comparison with atropine and homatropine. Acta Ophthalmol (Copenh) 1988;66:721-4.
19. Major E, Dutson T, Moshirfar M. Cycloplegia in children: An optometrist's perspective. Clin Optom (Auckl) 2020;12:129-33.
20. Saxena R, Vashist P, Tandon R, Pandey RM, Bhardawaj A, Gupta V, *et al.* Incidence and progression of myopia and associated factors in urban school children in Delhi: The North India Myopia study (NIM Study). PLoS One 2017;12:e0189774.