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Review Article

Assessment of pediatric visual acuity

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ABSTRACT

The VA assessment of children within the different age groups is a very tough task somewhat due to of cooperation of children. However, the method of estimation of pediatric VA is based on different types of concern according to age. VA is a compound function of the minimum visibility, resolution, recognition and minimum discriminability. Sometimes the VA is hampered due to the types of refractive error and the initial correction of the error is also an important issue. The 5 to 6 years of age children with normal growth respond easily and they can be observed with the adult method but the youngest school-age children can be estimated with nonverbal methods. The growth of social and educational development of the children can retard due to acuity impairment but early detection and visual correction enhances the issue.The pathological disorders in childhood like corneal and lenticular disorders, macular degeneration, tumours, multiple sclerosis etc., turning of the eye from the standard called strabismus and it happens due to the reduction of the VA and the loss of binocular vision. Thus visual acuity is an approach for the assessment of ocular health along with the visual brain and its pathway.

1. Introduction

VA is the property of the eye to distinguish two objects and the cones (photoreceptor cells) are assumed to perform the function.[1,2] Their higher density is found at the macula and considered for the resolution and colour vision, although VA and colour vision are separate properties due to their different physiological functions.

The elements that influence the spatial resolution are classified into two subheads. One of them is physical factors including light characteristics affect the nature of retinal image. The second physiological element concerns the processing of the stimulus. For example, entering light in the eye with its properties is the physical element and the reflex control like regulation of photo stimulation by the iris, and focusing of image i.e. accommodation, are the physiological factors.[3]

Visual acuity is measured through spatial resolution and is tested by a chart form characterized by the black symbols over the white background at a definite distance of six meters (20 feet) because for focusing on this distance the required negotiable power is around 0.164 D.

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Often visual acuity gets affected due to the refractive error and for the adult, it is evaluated by manifest refraction while for infants, children and handicapped individuals' refractive correction is made subjectively followed by retinoscopy or auto refraction. So the proper refractive correction lead with standard VA doesn't result in disability.

The VA measurement of infants and children has a different object and method comparatively to the adults, because of visual and cognitive development and instability of the vision which improves very fast at the first postnatal age. So prediction of visual status is very uncommon in infants and children but it can be modified with the help of additional approaches. An infant who has normal vision in early life and his or her visual system fails to maintain developmental changes between the age of infant and adulthood may intend with visual impairment and it's vice versa. The group of 5-6 years of age for children with natural growth can be assessed for their visual function by the procedures applied for the adults although the youngest school-age children can be observed with the nonverbal methods.

Visual acuity assessment in children remains a challenge due to a lack of cooperation in assessing refractive errors.[4,5] Pre-school children unilateral or bilateral and with or without severe lower visual acuity are usually unaware of their problem; even their parents are unable to suspect their children although most anisometropic children have small angle strabismus.

Some of the adults and school-age children have issues with language, physical, or cognitive abilities or even due to the illiterately cannot be tested for their visual functions on the standard. Therefore the best way to make an observation is to apply the younger children or infants test method for them, but it should be kept in mind that the status of acuity output typically becomes less accurate or fails to reveal visual deficit because it uses stimuli as in the grating system.

The VA of preschool-aged is checked with the improved methods consisting of subsets of letters, characters or matching of cards. Infants and children who can't perform such checks, are observed through electrophysiological or eye movement responses, but this test estimates resolution acuity instead of recognition acuity, therefore it underestimates some of the acuity suppression issues like Amblyopia.

2. Physiology of Vision

Standard VA is defined as the potential to differentiate spatial patterns which is defined by the visual angle of one minute of arc. One degree contains sixty minutes and a visual angle of one minute of arc is defined as 1/60 of a degree. The lightened area over the retina through the crystalline lens covers the area of the retina is about 288 μm which covers 120 colour-sensing cones. If more than 120 alternate white and black lines (grating) are crowded in the same defined area then they appear grey to the eye. This fundamental mathematically estimates the resolution of the eye at a particular distance.[6]

In the posterior region of the brain, the occipital lobe is situated, which consists of the cerebral cortex, further visual cortex in that area acts on transmitted visual stimuli from the retina. The neurons of the central 10° of the visual field represent the macular area and 60% of that is estimated in the visual cortex for the visual acuity.

The two basic photoreceptors named rods and cones are found in the retina of the human eye. Rods are assumed for their sensitiveness to blue-green light having maximum sensitiveness up to the wavelength of 498 nm, therefore applied for dark or dim light situations. Cones are considered for bright light and colour vision and are estimated in three categories L-cones essential for red light get a maximum sensitivity of up to 564 nm, M-cones essential for green light get a maximum sensitivity of up to 533 nm, and S-cones essential for blue light getting maximum sensitivity up to the 437 nm.

The count of the cones at the fovea is found around 180000/mm^2 which gets reduced up to 5000/mm^2 away from the area and at the blind spot (optic nerve head), they are found absent.

The visual cortex is connected to each retina of both eyes through the optic nerve which meat at the optic chiasm in a fashion of half of the fibers from each eye cross over with the other eye, these combined nerve fibers called optic tract, essential for binocular vision which runs from optic chiasm to the lateral geniculate nucleus situated at thalamus of the midbrain and thereafter it join to the visual cortex through optic radiation. It is assumed that the different ganglion cells are responsible for the relative frequentness of detail of the object known as a grating, considered for the different levels of resolving power.[7]

The pathological disorder related to vision in childhood stands long due to corneal disorders, lenticular disorders, macular degeneration, tumours, multiple sclerosis etc., eye turn to its normal called strabismus due to reduced visual acuity in co-ordination with loss of binocular vision and depth perception. Thus visual acuity is an approach for the estimation of ocular health along with the visual brain and its pathway.

3. Different Components of Visual Acuity

VA is a joint consequence of the different components, the minimum visibility, resolution, recognition and minimum discriminability.

Minimum visibility concerns an object's determination in an empty visual field known as the absolute threshold of vision, which depends on size, shape and illumination, like a black dot against a white background, a black square against a light background or a line with the minimum size of 30 seconds of arc.

The resolution factor also called ordinary visual acuity or minimum resolvable is a concern to determining the difference between two objects. The difference in distance between two objects is defined by the subtended angle at the nodal point. The normal angular threshold has the value of 30 to 60 seconds of an arc and is known as the minimum angle of resolution (MAR).

The recognition factor involves of cognitive component with the resolution factor as the adult identifies different human faces.

The minimum discriminability or hyper acuity refers to the lowering of the threshold level to the ordinary acuity. An example of minimum discriminable is vernier acuity where two parallel and straight lines are aligned in a plane. The threshold value of vernier acuity is considered within 2 to 10 seconds of arc.

4. Visual Perception

It depends on the four related factors, first, the light sense provides light minimum phenomenon which represents the minimum brightness level essential to evoke the light sense. Dark adaptation is the ability to adapt the low illumination and get a decrease in "vitamin A" deficiency, glaucoma and retinal dystrophy. The second is form sense can discriminate the shapes of the objects. Snellen's chart is the estimation of this sense depends on the density of cones arranged at the fovea. Third is contrast sensitivity, essential for the dissimilarity of the margins of the objects in the lighted area. It gets diminished in glaucoma, cataract, optic nerve disease, diabetes and refractive errors. Fourth is the colour sense based on cone property, which discriminates the colour.[1]

5. Visual Acuity Estimation

The highly complex visual acuity function consists of minimum visible, i.e. detection of stimulus, minimum separable, i.e. location judgment of an object and minimum resolvable (ordinary visual acuity), i.e. the capability to distinguish an object.

The nature of VA defines various tests, which are as follows-

Standard normal visual acuity and visual development in various age groups are defined by the American Academy of Ophthalmology, American Association for Pediatric Ophthalmology and Strabismus and the American Medical Association as follows-

The visual function can be recorded by one of the methods of the visual acuity test which gives quantitative value. For the neonates and the children, the available methods are not standardized yet but according to age following tests are used.

Table 1:

Detection acuity test	1. Dot visual acuity 2. Catford drum test 3. Boek candy bead test 4. STYCAR graded ball's test 5. Schwarting metronome test
Resolution acuity test	1. Optokinetic nystagmus 2. Preferential looking test 3. Visual evoked response
Recognition acuity test	1. Direction Identification a. Snellen's E chart, b. Landolt's C-chart test, c. Sjogren's hand test and d. Arrows test 2. Letter Identification Chart a. Snellen's letter chart test. b. Sheridan's letter test, c. Flook's symbol test and d. Lipman's HOTV test. 3. Picture Identification Chart (miniature toy test) a. Allen picture cards test, b. Beale Collins picture charts test, c. Domino cards test, d. Lighthouse test and e. Miniature toy test. 4. Picture Identification Chart (behavioural pattern) a. Cardiff acuity cards test and Bailey Hall cereal test

6. Blink Reflex and Vestibulo Ocular Test

This is an involuntary blink reflex related to the eyelid. As the cornea is touched or the light rays are projected, the peripheral stimulus acts as an indirect and consensual response to protect the eye. So as per the act, it is named corneal reflex, eyelid reflex or optical reflex.[8,9]

If the sound level goes beyond the 40-60 db then the same phenomenon occurs and is named vestibulo ocular reflex. The vestibulo-ocular reflex (VOR) is also tested by turning the newborn's head away from the source to note the reaction of the eye which moves opposite to the shifted head direction, this is called the doll's eyes response / Oculocephalic reflex. It helps to examine the IIIrd, VIth and VIIIth cranial nerves, named the Oculomotor, Abducens, and Vestibulocochlear nerve, along with brainstem nuclei and their functions.[1,10,11]

The VOR works even in total darkness or even when eyes are closed so does not depend on what is seen but in the presence of light, the fixation reflex coordinates with the head movement. It also gets stimulated with hot or cold stimulation of the inner ear, the site of the vestibular system.

The absence of optical reflex is found in below nine-month-old infants. Although optical reflex is counted as slow than of corneal reflex because it is mediated by the visual cortex of the occipital lobe of the brain.

Table 2:

Age groups	Visual acuity		Physiology	Status	
29 weeks of gestation to 5 months	6/120 (20/400)		Papillary reaction to Menace Reflex with sensory fusion and beginning of accommodative efforts	**Neonates** Birth to 1 month	**Pre School Age**
6 to 12 Months	6/60 (20/200) to 6/36 (20/120)		Sensory fusion and accommodation established with the beginning of stereopsis	**Infants** 1 month to 12 months	
1 to 3 years	6/18 (20/60) to 6/6 (20/20)		Visual differentiation of objects to the picture and letter matching	**Children** 1 to 12 years	**School Age**
3 to 5 years	6/6 (20/20)	Low VA refers to refractive error	Picture and letter matching to the stereopsis development	**Adolescence** 13 to 17 years	
> 5 years	6/6 (20/20)		Well develop Stereopsis and VA	**Adult** > 18 years to 59 years	
				Older Adult > 60 years	

Table 3:

Age Group	Prefered Examination	Short Description
Birth to 3 months	Blink reflex test	Blinking response to the bright light is assessed
	Pupillary light reflex test	The most reliable test, a Semi-dark room with a well-focused beam
	Vestibulo ocular reflex test (Doll's eye reflex)	Eye deviates opposite to the direction of head rotation
	Eye-popping test	Dim light responds to the open eye wider
	OKN test (Opto Kinetic Nystagmus)	Objective method for infants/children/adults/Co-operative/un co-operative
	VER (Visual Evoked Response)	Occipital lobe response is noted about visual stimuli 1. **Flash VER** – performed in very young children 2. **Pattern reversal VER** – depends on form sense & gives a rough estimation of VA.
	Fixation behavior test	Monocular/Binocular, Violently resist occlusion of the better eye
3 to 6 months	CSM	CSM grading is used for binocular fixation preference (BFP) testing. Used in strabismic amblyopia but couldn't differentiate the depth of the amblyopia.
	Menace reflex	Develops at the age of 5 months. Blink in response to a rapidly moving object or visual threat.
	Bruckner's reflex	Used for gross estimation of the refractive errors. Both eyes are simultaneously illuminated with the direct ophthalmoscope at a distance of 1 meter. An inferior crescent suggests myopia and is superior to hyperopia
	Cover test	One is occluded to observe second- 1. If deviates-strabismus. 2. Exo-eye moves inward from the centre/temporal 3. Eso-eye moves outward from the centre/nasal
	PLT (Preferential looking test)	
6 to 12 months	TEC (Teller acuity card test)	
	Catford drum test	
1 to 2 years	Lea acuity card	
	Broken wheel test	
2 to 5 years	Illiterate E-cutout test	
	Sheridan-Gardiner HOTV test	

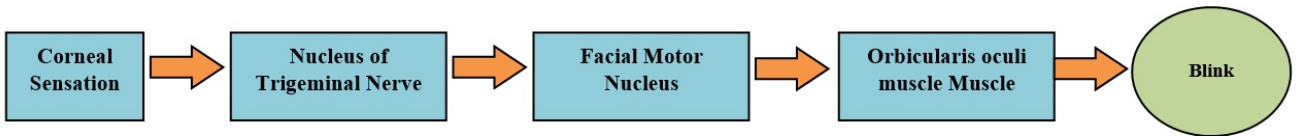

Figure 1:

The corneal reflex has a consensual response and is used for the neurological examination (the main difference with the optical reflex) for the evaluation of coma, and damage to the trigeminal nerve, resulting absence of corneal reflex during stimulation of the affected eye.

7. Pupillary Light Reflex Test

It is a diagnostic tool for checking the sensory and motor functions of the eye (afferent and efferent visual neurologic pathways).[12] This reflex is useful for premature babies having a gestational age of over 29-31 weeks and is the most reliable test for visual determination except for cortical blindness.[1] The pupillary response is modulated by cognitive factors, like attention and awareness of the visual input. It gets affected by optic nerve injury, oculomotor nerve damage, brain stem lesions, and depressant drugs.[13,14]

The desired atmosphere is a semi-darkened room with projecting light properties that should be small, well-focused and bright. The observation against the projected light sometimes needed a magnifying glass because of the smaller size of the pupil.[1]

A light is thrown over the eye to check its pupillary reflex, named direct pupillary reflex, after a few seconds again light is thrown on the same eye but the second eye's pupillary response is checked, named consensual pupillary reflex. Both eyes are observed for the appearance and function of the pupil against the light reaction and are documented as PERRLA (pupil is equal, round and reactive to light and accommodation).

The light reflex is noted between 0 to 4^+ grading. A normal person is noted with 4^+ (brisk and large response), 3^+ (moderate response), 2^+ (small, slowed response), 1^+ (worst response), and 0 (unresponsive). The normal pupillary reaction takes about one second of time for constriction and 5 seconds for dilation.[14]

The abnormal response depends on the site of damage- Optic nerve damage leads to complete visual loss. Damage before the optic chiasm engaged by the bilateral ipsilateral monocular visual loss- RAPD (relative afferent pupillary defect)- Marcus Gunn pupil- checked by the swinging flashlight, cause- ischemic retinal diseases (BRVO, CRVO, BRAO, and CRAO),[15] ischemic optic neuropathy, optic neuritis, nerve compression, trauma or due to asymmetric glaucoma, secondary to retinal nerve fibre layer loss. Argyll Robertson pupil leads to bilateral weaker or absence of pupillary light reflex although the pupil constricts for the near response, causing neuro-syphilis.[16]

Optic chiasm damage causes bitemporal hemianopia and has concern for the pituitary adenoma. The damage to the optic tract causes contralateral homonymous hemianopia; for instance, damage to the left optic tract provides right visual field deficits for both eyes.[14,17]

The disruption between the balance of parasympathetic and sympathetic innervation, (Horner syndrome) leads to loss of sympathetic stimulation and miosis of the ipsilateral pupil takes place.[16] Short-term consequences of transient mydriasis can be associated with antidepressants and antipsychotics, beyond this, some medications used in migraine can cause acquired myopia and angle-closure glaucoma.[18]

The fixed dilation of pupils was also noted in ICP (increased intracranial pressure) as in coma patients. Tumours or lesions affecting the optic chiasm or midbrain cause pupillary constriction. The tumours of the retina, optic nerve, and brain may also cause RAPDs. The children have the most common intracranial tumour glioma and the most common intraocular tumours are developmental cysts (benign) and retinoblastoma (malignant).[19]

RAPD may persist in severe amblyopia with BCVA 20/400 or worse.[19] Pupillary escape takes place in the diseased optic nerve and has a concern with the transient pupillary constriction which leads to a slow dilation.[20]

8. Eye-popping Test

It is a unique test for babies, and it doesn't work well for the very young infant. The eye-popping reflex can detect changes in the room illumination. As on dimming of light upper eyelid of both the eyes, pop open wide at the time and often closes the eye as the light is brought up back. This is documented as +ve eye-popping.[1]

9. Optokinetic Nystagmus Test

This objective method of visual assessment is used for infants, uncooperative children and for adults too. The visual angle which is subtended by the smallest strip width and defines an eye movement (mini-mum separable) is a measure of visual acuity. If the child is cooperative, then reported acuity assessment is considered 6/120 for newborn, 6/60 at 2 months, 6/36 at 6 months and 6/6 at 20 to 30 months.[1,21–24]

10. Catford Drum Test

It was introduced by Olive and Catford. Objectively it determines the VA between 20/20 (6/6) to 20/600 (6/60) of Snellen's acuity based on the black dot-size object of varying diameter size (0.5 to 15 mm) on the white background, with the applied at the depth of 60 cm. The drum used for observation is motor-driven allowing it to rotate in both directions, to induce optokinetic nystagmus (oscillating evokes pendular movements). The endpoint is recorded and converted to Snellen's equivalent.

However, it is useful for infants and children and is supposed for unreliable visual acuity estimation; it gives false positives in infants having cortical blindness and false negatives in infants with delayed development of the motor pathways.[1,25]

11. Visual Evoke Response

Electrographic responses were first introduced with the strobe flash clinically and named encephalograms (Adrian and Matthews, 1934). It refers to an electroencephalogram (EEG) that records the visual stimuli at the occipital lobe (Hans Berger's 1929). It is quite a purposeful objective technique for checking the visual function of infants.

According to the age of children two different procedures applied. Flash VER is used either in very young children or those who can't fixate on target; it gives the details between the macula and visual pathway. Pattern reversal VER is estimated through checkerboard patterned stimulus which takes change on the same illumination i.e. black and white squares turn opposite to their colours respectively. It gives a rough estimation of VA due to changes in form sense.

Various studies suggests that VER shows visual acuity in infants 6/120 at the age of 1 month, which improves up to 6/60 at 2 months of age and up to 6/12 to 6/6 at the age of 6 months to 1 year. The disadvantages of VER is expensive, time-consuming, limited availability, is not standardized and has little clinical relevance.[1]

The positioning of electrodes depends on the 10–20 International System and depends on measurements of head size (Jasper, 1958)[26]

1. The mid-occipital electrode (OZ), known as positive pole, is fixed at the midline, and the distance above the inion (prominent projection of the occipital bone at the posterior-inferior part of the skull) is 10% of the distance between the inion and nasion (the most anterior point of the frontonasal suture that joins the nasal part of the frontal bone and the nasal bones), almost considered to 3 to 4 cm in most of adults.
2. The upper forehead location responds to the Fpz as a -ve pole.
3. Lateral occipital electrodes, named O1 and O2 are placed at similar distances of the midline.
4. The next electrode array is the Queen Square system (used for hemifield stimulation), where the mid-occipital electrode is fixed 5 cm above the inion on the midline with the lateral occipital electrodes 5 cm lateral from the midline (Blumhardt et al., 1977).
5. The reference electrode is usually placed either on the earlobe/the midline top of the head/forehead.
6. The –ve (ground) electrode is fixed at any area but it should be isolated from the electrical environment of the room.

12. Fixation Behaviour Test[1]

This is based on the fixation and the personal properties of children with the help of an interesting object. The test is carried binocularly followed by monocularly. If the child fixates with one eye, means poor vision in the non-fixating eye and the child will try to remove the cover of the better eye.

13. CSM (Central, Steady, Maintained)[1]

The light is projected over the cornea of the infants and the fixation is checked by the corneal light reflex as it should fall monocularly at the centre of the cornea (central). Now the small target is coupled with the light and moved slowly in front of the eye of the child to observe any oscillation nystagmus/unsteady or steady fixation, and if the eye remains fixed, named maintained either if eye is covered.

The interpretation of the acuity is 6/9 to 6/6 for CSM, if CS is not maintained (CSNM) then VA is 6/36 to 6/60 and for the unsteady central fixation VA is counted < 6/60.

14. Menace Reflax Test[1]

The reflex of the covered eye is represented when any object is taken in front of the eye suggestive of normal vision.

15. Bruckner Test

Fixation and binocular comparison of the red reflex is examined by the dim light illumination of both the pupil at the same time, at a depth by the single direct ophthalmoscope. The observation is made over the dilated and undilated obscured papillary space of the red reflex and its whitening.

Positive result intended with a low level of strabismus or anisometropic Amblyopia and attained with the whitening of the red reflex. So this test is very helpful for uncooperative children.

16. Cover Test

The re-fixation reflex is noted with the cover test, if one eye is occluded then the second eye shouldn't move, but if it is that means strabismus is there.

This gold standard, objective method is used to determine the ocular deviation in both near (fixation target applied at 33 cm) and distance (fixation target 6 mt) as well. The initial cover-uncover test is used to differentiate tropia and phoria. The fixating eye is blocked for a few seconds with the occluder and removed to check the status of the second eye. If a non-occluded eye takes fixation, tropia is present, otherwise eye will remain stationary. In the case of phoria (latent deviation), when the occluder is removed, the same eye returns to take fixation.

The alternate cover test is followed by the cover-uncover test, which measures the total deviation including poria and tropia. For doing the test both eyes are covered alternately at the frequency of a few seconds to allow taking fixation.

During the examination, one eye is occluded alternately, and the process is repeated between both eyes. When performing the alternate cover test, the occluder is shifted over each eye and it is taken on hold for a few seconds to allow sufficient time for the non-occluded eye to take fixation. In general, the faster the eyes can recover when the occlusion is switched, the better the control of the deviation. [1,27,28]

17. Preferential Looking Test

The two adjacent stimulus fields, one of them striped and the second is a homogeneous field brought against the eyes of an infant to note the time reaction, preferred high for the striped pattern.

The examiner hides his face behind the pattern screen and to make an observation he looks through an aperture, facilitated in the center of the pattern screen. The stimuli are always randomly rotated with different screens. [1]

18. Teller Acuity Card Test

This technique is a modified form of PLT and is used frequently in clinical practice due to its simplicity, reliability and efficient performance. It is carried over a distance of 36 cm for infants, 54 cm for children and 84 cm for the adult. The VA is estimated with the TAC grating system, indicating an increase in acuity during the first 6 months to 5 years of age (1.0 cycle/degree at 1 month to maximum 5.0 cycles/degree at 6 months and thereafter a gradual increase takes place up to 40 cycles/degree). The results in cycles are converted to Snellen's equivalent by the conversion table.

This test contains 17 cards, a set of vertical black-and-white bars of varying size with a small hole in the centre of the card through which the observer checks the fixation. The varying of the spatial frequency of the bars at its extreme provides no longer preference for the patterned stimulus by the infant.

The determination of Visual acuity range lies at 6/240 (newborn), 6/60 (3 months) and 6/6 (36 months) In routine, children grating acuity is much advocated instead of the recognition acuity. The neural visual process in the brain has involvement with the spatial discrimination and recognition tasks therefore grating acuity is not comparable to the recognition acuity. [1,29–31]

19. Lea Acuity Test

Dr. Lea Hyvarinen (1993-1994) was the inventor of this test including different pictures like objects, circles, squares, houses and apples designed on the device. It has two technical basic features, it has equal blur due to good optotype among all, second is calibrated against Landolt's C type, so the language barrier issue is eliminated easily. [1,32]

20. Miniature Toy Test

Initially, this test was applied to the handicapped and mentally retarded children. the observer stands at a distance of 10 feet away from the child with one set of toys and the child insists on picking the same object with the provided second set of toys to the child.

The objects/toys include automobiles, planes etc. like toys have their various sizes to check the grades of the vision. [33]

21. Coin Test

Different sizes of coins are shown to the child and asked to pick the coin. [33]

22. Broken Wheel Test

This test is applied for toddlers and preschoolers who do have not the ability to perform matching tasks. The child is asked to point a car for the broken wheel of the car among a different progression of the car size. The different seven cards used one by one in a sequence at a distance of 10 feet equivalent to Snellen's 20/20 to 20/100. [1,33]

23. Illiterate e-cutout Test

$2\frac{1}{2}$ to 3 years of age children are tested for visual acuity by giving them an "E" cutout with the instruction to match it with the given "Es" of different sizes and directions. After a little time, duration child cooperates with the procedure. [1,33]

24. Tumbling e-pad Test

It is the same as the "E-cutout test", with the difference of different sizes of "E" in one of the four positions drawn on a sheet, further, it was modified by the Sjogren where "E" was replaced by the figure of hand and the test is named Isolated hand-figure test. [1,33]

25. Sheridan-gardiner HOTV Test

This test also has a resemblance to the "E-cutout test". On a given card, the child is instructed to match the letter on the chart and Snellen's equivalent is considered 6/6 to 6/60 for the visual assessment. [1,33]

26. Pictorial Vision Chart

If the child can explain verbally then this procedure is most purposeful, where pictures are devised in various charts. Pictorial vision charts include the Kay picture test, Allen cards test, Lae symbols test and BUST (an acronym for the Swedish words for 'visual and picture perception test').

Allen cards test has seven optotypes applied for the visual acuity assessment at a distance of 15 ft (20/40) for the 3 years of age the child, whereas 20 ft (20/30) for the 4 years of age of the child. Kay Pictures test has a picture optotype in the form of a test book to assess visual acuity in young non- verbal children at a distance as well as near. It is used at 6 meters and if the child is not attentive then the distance is lowered up to 3 meters. For the near vision assessment, a near-point card is used. BUST is also a picture test for the visual assessment of children. The VA range for the distance acuity goes from 0.02 to 1.6 (20/1000 to 20/10). [1,33]

27. Boek Candy Bead Test

The child is asked to match beads at a distance of 40 cm. and its resemblance goes equivalent to 20/200 of Snellen's visual assessment. [1,33]

28. Worth's Ivory Ball Test

Claud Worth (1896) introduced the ivory ball test. It was recommended for the VA assessment for children between 1-3 years of age. A set of 5 balls ranging from 0.5 inch to 2.5 inch is used to test VA with the occlusion of one eye, the ball is thrown in a sequence of larger to smaller at a distance of 18 feet and the child is asked to retrieve the particular ball. [34]

29. Marble Game Test

It is used for the 6-12 months of age of children, the child is instructed to place marble in the holes of a card with a proper match. So the test is intended for the visual function of the eye rather than for VA estimation, therefore visual documentation is mentioned as being useful / less useful. [1]

30. Light Home Picture Cards

It contains an apple, a house and an umbrella, arranged in a pattern like Snellen's equivalents of 20/200 to 20/10 to observe at 10 ft, to identify the pictures along the lines. [1]

31. Discussion

The cooperation of the child if available and visual acuity should be checked through the method which is generally applied for the adults concludes standard optotypes with logarithmic estimation of acuity. So the preschool-age child can be tested with a standard adult test like the ETDRS chart, Bailey-Lovie chart, or Lea symbols test, it is important to compare the child's acuity level according to age with the available pre-data, as it couldn't be the same to the adults. The best method to check the visual acuity of Infants and young children is electrophysiological and behavioral techniques although it shows an improvement from the first six postnatal months to the next one to two years. The demerit of such tests is that they work on eye movement responses to large grating stimuli so may underestimate the visual acuity deficit due to the conditions affecting the macula (macular degeneration and Amblyopia).

32. Conclusion

Visual acuity assessment is subjective, making patient cooperation crucial, especially in challenging cases like illiteracy or testing young children. While logMAR and electronic methods hold particular value, considerations around cost-effectiveness and required skills cannot be overlooked. Other commonly used methods of visual acuity evaluation aim to enhance daily functioning and overall quality of life, though they generally offer only approximate measurements of acuity. Further research, particularly focusing on age-specific data and neurodevelopmental responses, is essential to establish a more accurate and ideal standard for visual acuity assessment.

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34. Conflict of Interest

None.

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