Lecture1+2 (Colour vision testing)

Introduction

Human retina contains photoreceptors; Rods and Cones, which are responsible for night/dark vision and colour vision respectively. Human colour vision is the amalgamation of red, green, and blue lights. Colours are perceived by cones and signals are generated which are mixed by the brain and create wide spectrum of colour that we perceive.

Colour vision is a function of photoreceptors present on visual pigments. Any disease affecting the photoreceptors, optic nerve fibers can affect colour perception of an individual.

Color vision deficiency(CVD), is the inability or decreased ability to perceive color differences under normal lighting. Most of the CVD are congenital but seldom it may be acquired as well. The four types of CVD are Protan (red), Duetan (green), Tritan (blue), and Achromatopsia (total absence of colour vision).

Normal colour vision

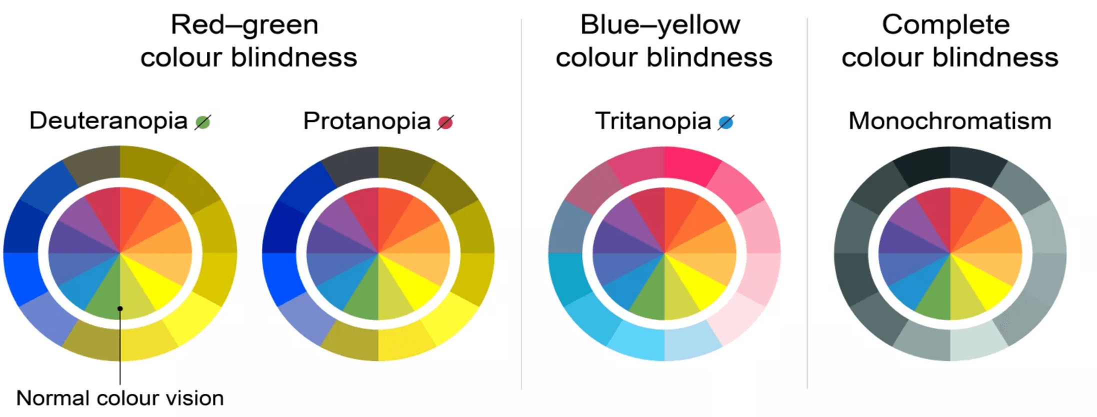
Severe red/green colour blindness

Colour vision testing

Colour vision testing often forms integral part of ophthalmology examinations for job requirements and at times its anomalies are crucial to the diagnosis of various retinal and optic nerve diseases in ophthalmology. Hence, it is imperative to have a sound knowledge about the physiology of colour vision and its anomalies.

The number and type of cone that is missing or malfunctioning can have a major impact on the way that a person sees the world around them. As a result, there are several different types of color blindness:

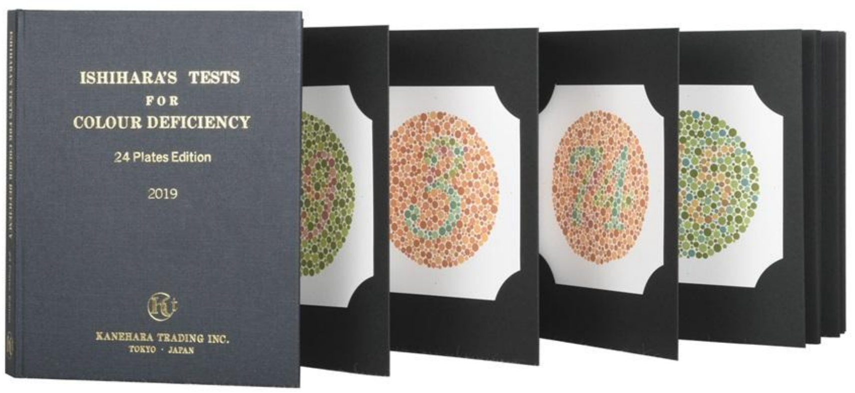
- **Protanopia:** Also known as red-blind, this type is for those with no red cones. They can see no red light. They see mostly shades of blue and gold. Reds are often confused with black. Dark brown can also be troublesome.
- **Deuteranopia:** Sometimes known as green-blind, this type is for those with no green cones. They mostly see blues and golds. Reds can be mistaken for greens, and certain yellows may appear similar to bright greens.
- **Tritanopia:** Known as blue-blind, this rare type has no blue cones. People cannot see blue light. They mostly see reds, pinks, and lavender.
- **Achromatopsia:** Sometimes called monochromacy, this condition presents in people who have no working cones. They see the world in shades of gray. They also frequently have to deal with other vision issues.



Ishihara test

It was named after its designer, Shinobu Ishihara, a professor at the University of Tokyo, who first published his tests in 1917. Since then this is the most widely used and well known color vision deficiency test and still used by most optometrists and ophthalmologists all around the world.

Ishihara is the most commonly used conventional test for color blindness testing. This test consists of a series of plates filled with colored dots that form numbers or shapes visible only to those with normal color vision. By interpreting these patterns, eye care professionals can determine the presence and type of color vision deficiency in an individual. The Ishihara test is a collection of stacked pictorial cards and colored spots; each plate consists of small dots of different colors and sizes. Dots of a similar color form a number, shape, or path on a background of dots of similar but slightly different hues. often used to diagnose red–green deficiency (Deuteranopia/Protanopia). It is not accurate for detecting blue-yellow vision defects (Tritanopia).



Testing guidelines for Ishihara test:

1. The plates must be read in daylight or artificial light resembling daylight.
2. The book should be held 75 cm from the patient at right angles to the line of vision. The person is asked to identify the number or shape they see in each plate.

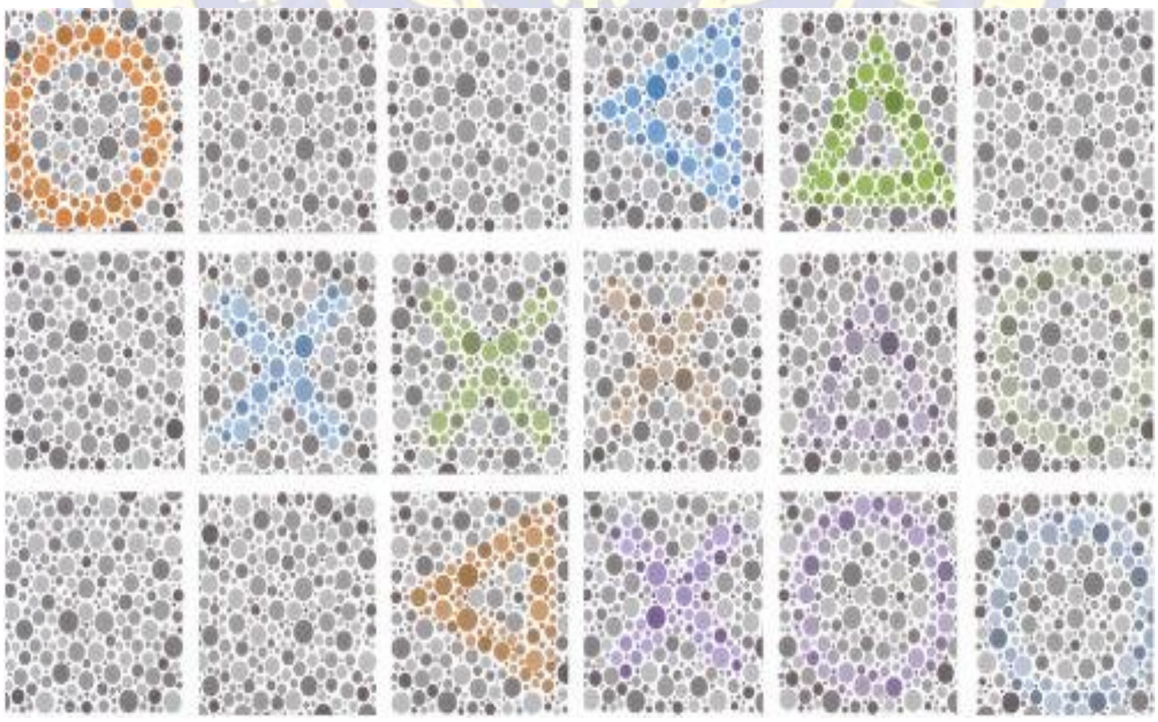
3. The patient should be given 3-5 second to identify each plate.

4. The patient should use his/her near vision correction.

5. Avoid tinted spectacles or contact lenses.

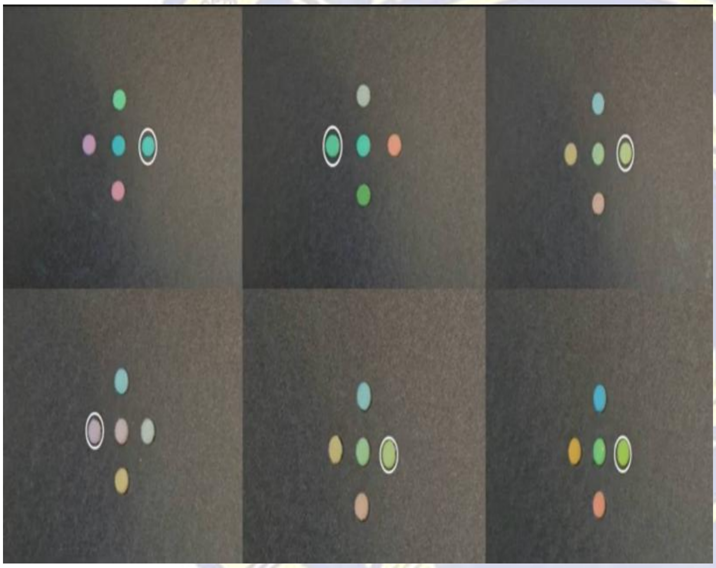
Hardy–Rand–Rittler plates (HRR)

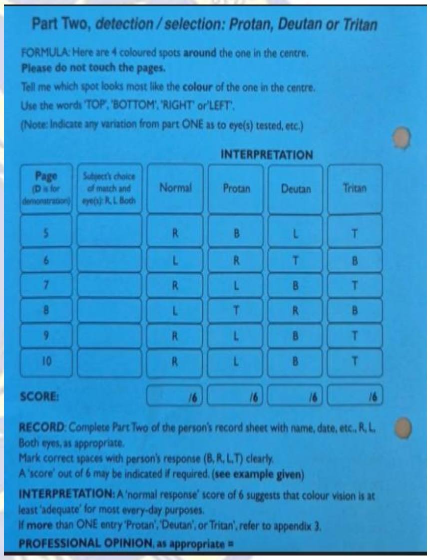
HRR This test is considered an important evolution of the Ishihara test, developed by Hardy, Rand, and Rittler in the mid-20th century. Similar to Ishihara (plates with colored dots) but it uses geometric shapes (like a triangle, circle, X) instead of numbers. This makes the test suitable for young children or illiterate persons. It not only detects red-green defects but also effectively identifies blue-yellow vision defects (Tritan defects), making it a more comprehensive test. The test identifies not only the type of defect (red-green vs. blue-yellow) but also its severity (mild, medium, strong). The test book contains 24 plates: 4 plates for demonstration, 6 plates for screening, and 14 plates to diagnose the severity of color deficiency



The City University Test (CIT)

This is a quick and common clinical test, developed at City University, London. The test consists of a series of ten plates. On each plate five circles mounted on a black matte background are displayed: a central and four peripheral colours of equal size. Subjects are asked to select which of the four peripheral colours is most similar to the central colour. It helps screen for both red-green and blue-yellow defects. It is considered a rapid screening test, not as diagnostically accurate as HRR or FM 100. Choosing the wrong circles indicates a potential type of color blindness.





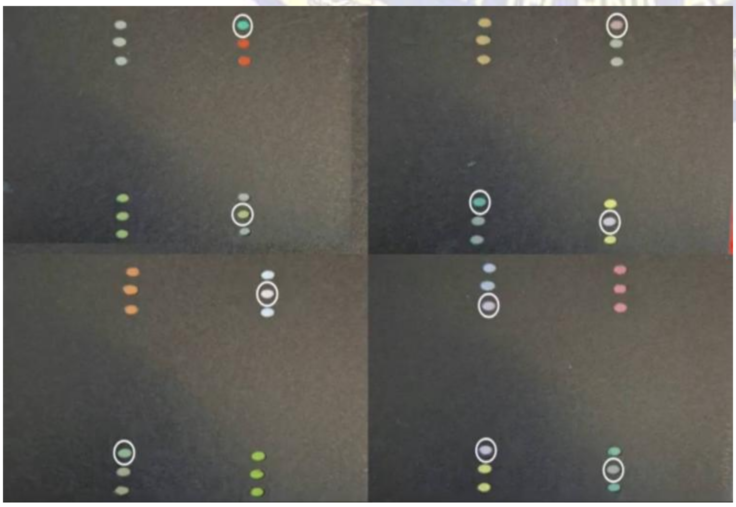
Part Two, *detection / selection: Protan, Deutan or Tritan*

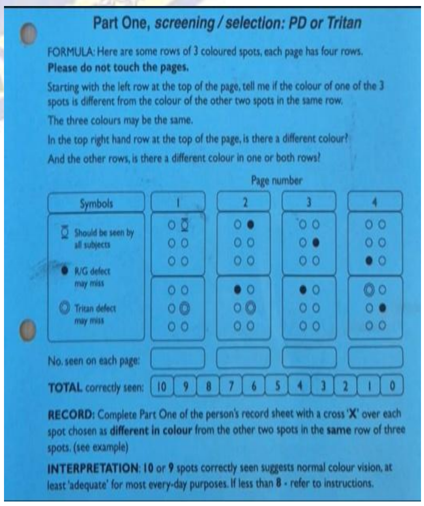
FORMULA: Here are 4 coloured spots **around** the one in the centre.
Please do not touch the pages.
Tell me which spot looks most like the **colour** of the one in the centre.
Use the words 'TOP', 'BOTTOM', 'RIGHT' or 'LEFT'.
(Note: Indicate any variation from part ONE as to eye(s) tested, etc.)

Page (D is for demonstration)	Subject's choice of match and eye(s): R, L Both	INTERPRETATION Normal	Protan	Deutan	Tritan
5		R	B	L	T
6		L	R	T	B
7		R	L	B	T
8		L	T	R	B
9		R	L	B	T
10		R	L	B	T
SCORE:		/6	/6	/6	/6

RECORD: Complete Part Two of the person's record sheet with name, date, etc., R, L, Both eyes, as appropriate.
Mark correct spaces with person's response (B, R, L, T) clearly.
A 'score' out of 6 may be indicated if required. **(see example given)**

INTERPRETATION: A 'normal response' score of 6 suggests that colour vision is at least 'adequate' for most every-day purposes.
If **more** than ONE entry 'Protan', 'Deutan', or Tritan', refer to appendix 3.
PROFESSIONAL OPINION, as appropriate =





Part One, *screening / selection: PD or Tritan*

FORMULA: Here are some rows of 3 coloured spots, each page has four rows.
Please do not touch the pages.
Starting with the left row at the top of the page, tell me if the colour of one of the 3 spots is different from the colour of the other two spots in the same row.
The three colours may be the same.
In the top right hand row at the top of the page, is there a different colour?
And the other rows, is there a different colour in one or both rows?

No. seen on each page:

TOTAL correctly seen: 10 9 8 7 6 5 4 3 2 1 0

RECORD: Complete Part One of the person's record sheet with a cross '**X**' over each spot chosen as **different in colour** from the other two spots in the **same** row of three spots. (see example)

INTERPRETATION: **10** or **9** spots correctly seen suggests normal colour vision, at least 'adequate' for most every-day purposes. If less than **8** - refer to instructions.

The Farnsworth-Munsell 100 Hue Test (FM 100)

The Farnsworth–Munsell 100 Hue Color Vision test is a test of the human visual system often used to test for color blindness. The system was developed by Dean Farnsworth in the 1940s, and it tests the ability to isolate and arrange minute differences in various color targets with constant value and chroma that cover all the visual hues described by the Munsell color system.

This is a highly precise quantitative test that not only detects the presence of a defect but also measures the degree of color discrimination.

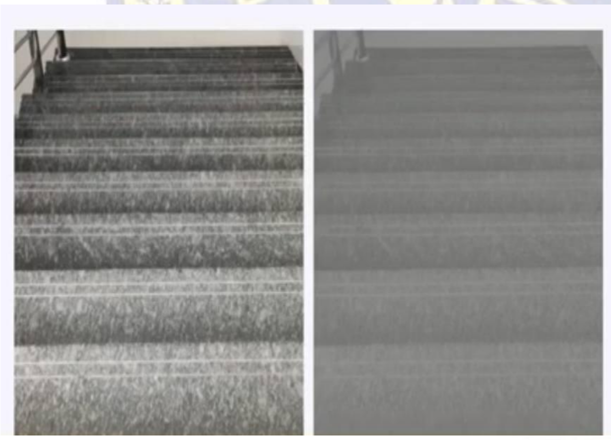
It consists of 100 small discs (or 4 trays, each containing 25 discs), each a different color but all of the same value and chroma. Together, the discs represent a full color cycle. The discs are given to the person in a random order. They are asked to arrange them in a gradual sequence to create a smooth and continuous color gradient. It detects all types of color vision defects (red-green, blue-yellow) and identifies them precisely. A "Total Error Score" is calculated. The higher the score, the greater the impairment of color discrimination. The direction of the errors (axis of confusion) determines the type of color vision defect. The test takes longer (15-20 minutes) and requires high concentration.

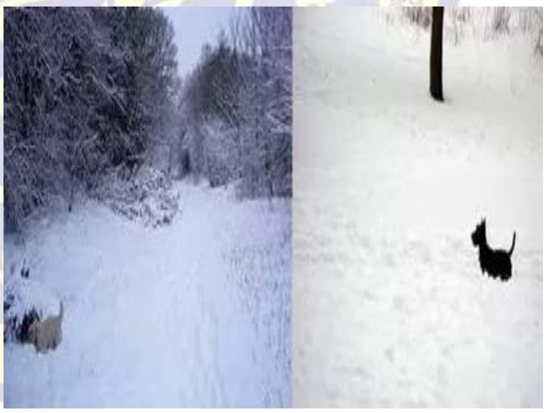
Lecture 3+4 (Contrast sensitivity (C.S.))

Introduction

Contrast sensitivity (C.S.) is the ability of your eyes to distinguish between an object and the background or the ability of the eye to detect small changes in illumination at targets that do not have clearly defined limits. Measuring C.S. is just as important as V.A. and is now universally accepted as complementary as it reflects the quality of vision and in many cases declines earlier, while V.A. remains normal (6/6 or better). C.S. defines the threshold between visible and non-visible, which has both elementary and clinical significance in the science of vision.

High contrast objects, such as white text on a black paper, are easy to see. Low contrast objects are more difficult to detect, such as a gray car on a cloudy day.





Having good contrast sensitivity is essential to visual functioning, especially in low-light conditions. Everyday situations that require contrast sensitivity include:

- Driving at night, in rain, or fog
- Seeing pedestrians or animals when driving

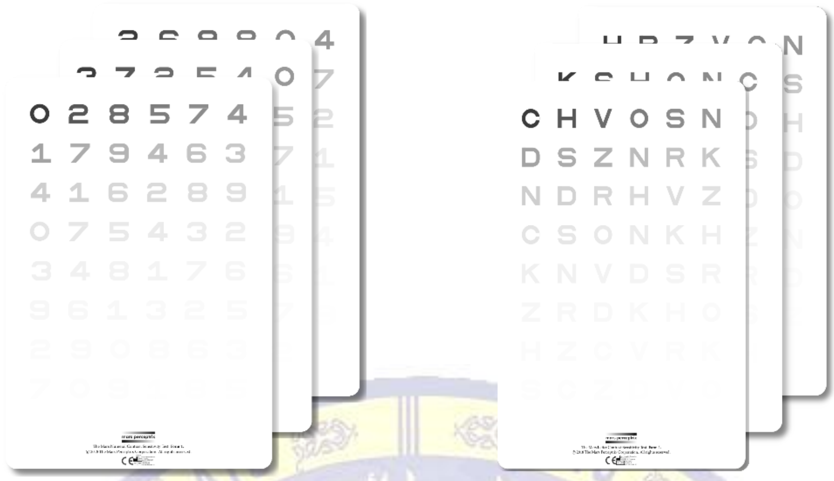
- Walking down curbs or stairs
- Locating objects against similar colored background
- Distinguishing people’s facial expressions

Contrast sensitivity plays a large role in the ability to safely perform activities, like walking down stairs and driving at night. Contrast sensitivity is affected by eye conditions such as cataracts and glaucoma. An eye doctor can test your contrast sensitivity and see if it is reduced from normal levels.

Contrast sensitivity testing results assist the clinician in determining the patient’s magnification needs, their ability to use optical magnification devices and the patient’s illumination needs. As we know, illumination is critically important for optimum visual performance. Finally, contrast sensitivity testing helps clinicians to monitor changes in visual functioning over time.

The Pelli-Robson chart

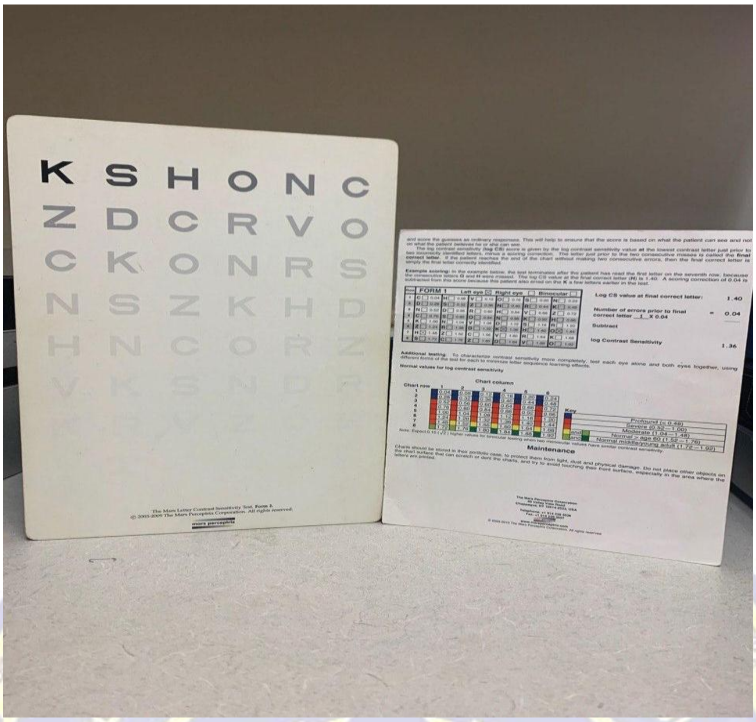
consists of letters of equal size, in sixteen triples, with a decrease in brightness of 0.15 log units per triple. The test is set one meter from the person examined and the letter size is 4.9 × 4.9 cm and consists of eight rows of letters. The Pelli-Robson test is easy to use as it resembles the V.A. measurement that most patients are familiar with, its fast and with good repeatability. It is ideal for cataract detection, screening of patients with intraocular lenses and for checking drivers for impaired vision. The patient's CS is determined by the last triplet’s letter in which he or she will be able to read two of them. Norms for different levels of contrast loss are Normal:



- when the patient can read 6-7 lines (12-14 triplets).
- Moderate contrast loss is based on the patient only being able to read 4-5 lines.
- Severe loss is when the patient can only read 2-3 lines.
- profound contrast loss is when the patient can only read 1 line or less.

Procedure

1. The chart is mounted on a wall at a standardized distance of 1 meter from the patient.
2. The patient is instructed to read the Sloan letters from left to right, starting at the top of the chart and moving down line by line.
3. The patient reads the letters, which are arranged in groups of three (triplets) of the same contrast. The contrast decreases with each subsequent triplet.
4. The test ends when the patient cannot correctly identify two out of the three letters in a triplet.
5. The contrast sensitivity score is determined based on the last triplet where at least two letters were read correctly. The score is recorded in log units, with a higher score indicating better contrast sensitivity.

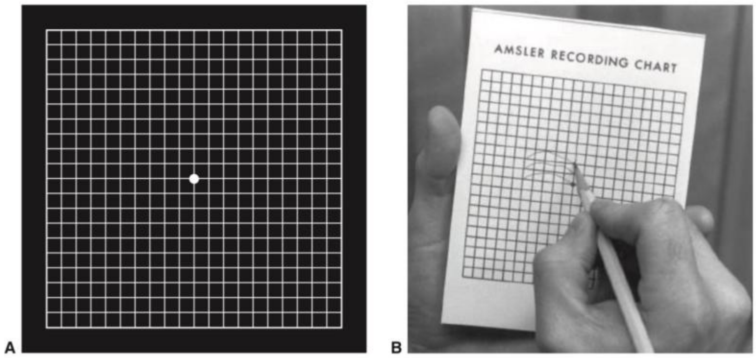


Most common errors

1. Not allowing the patient at least 20 seconds for the letters to become visible when the patient is near threshold.
2. Not pushing the patient to guess.
3. Inappropriate use of the occluder so that the patient can see the chart binocularly when monocular measurements are being made.
4. Inappropriate illumination (generally too low or not uniform

Amsler Grid

The Amsler Grid is a rapid, qualitative technique designed to test the central 10° of the visual field, using a standard chart with a grid of white lines on a black background. Each square of the grid is 5 mm, subtending approximately 1° at 30 cm. The patient is requested to describe lines that are missing or distorted.



The Amsler grid. A, the test pattern has white or red lines on a black background. B, the patient draws the central field defect on the preprinted pad that has black lines on a white background

Procedure:

1. Seat the patient comfortably with appropriate near correction (preferably single-vision or trial lenses, not multifocal).
2. Test distance= 30 cm; absolute presbyopia may use +3.25 D add otherwise patients own near glasses are acceptable.
3. Occlude the non-tested eye.
4. Ask the patient to hold the chart at 30 cm.
5. Keep room lights on (ambient lighting is sufficient, no need for strict control).
6. Have the patient draw the area of visual distortion or loss on the preprinted Amsler grid notepad. Be sure to note the date, patient's name, and tested eye. Test both eyes and record all results, whether abnormal or not.

Advantages

1. Measure the central 10° visual field.
2. Quick and easy to use.
3. Portable, suitable for home visits.
4. Allow home monitoring.

5. White-on-black charts are more sensitive to macular changes than black-on-white.

Disadvantages

1. Poor patient compliance with home monitoring.

2. Less sensitive, specific, reliable, and valid compared to standard perimetry.

3. Unable to detect small scotomas (<6°) effectively.

4. Rely heavily on subjective interpretation.

5. Affected by completion phenomena (filling in of small gaps by perception)

6. Reported distortions often overlap with scotoma areas, limiting accuracy.

Most common errors

1. Not ensuring that the patient views the central fixation target throughout the test.

2. Using an incorrect working distance.

3. Using an inappropriate near correction.

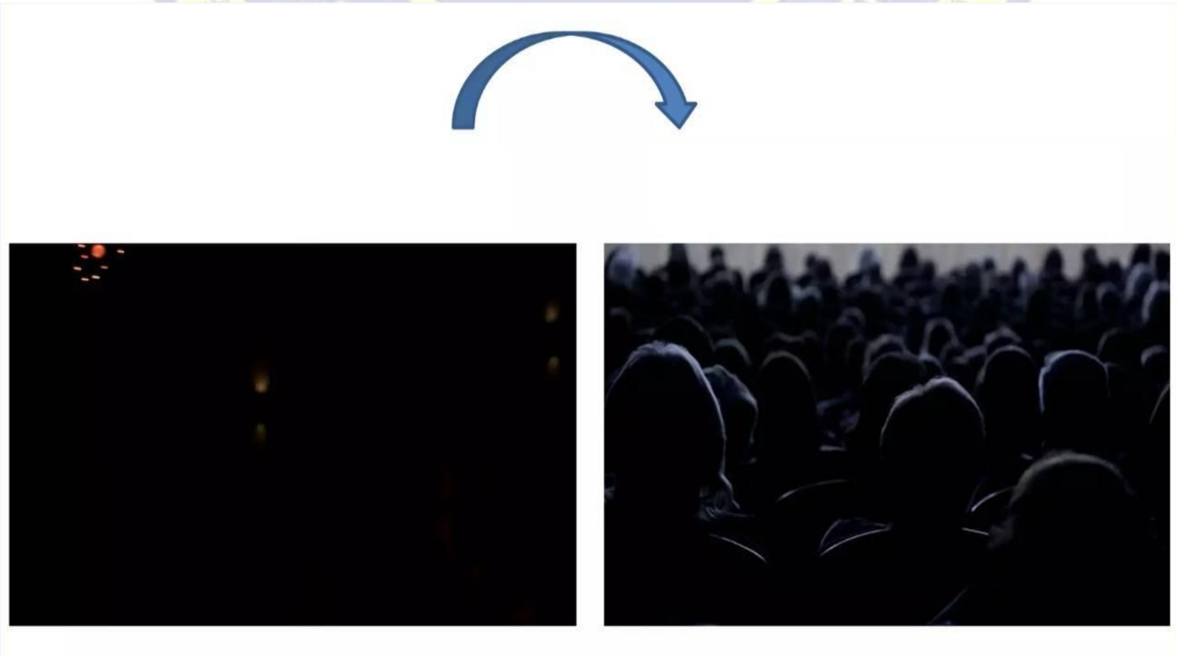
4. Using the patient's bifocals with a small reading area.

5. Performing the test binocularly

Lecture5+6 (Dark adaptometery)

introduction:

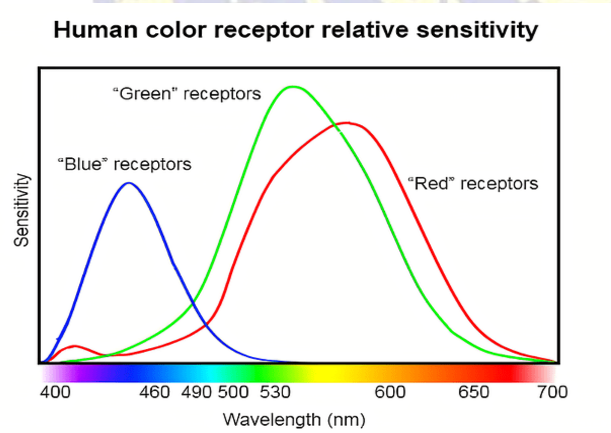
the many vision diseases are one that of the affect most vision important are related senses with of man. the retina. Some of these diseases affect specifically the photoreceptors, the light-sensing cells that are the first stage of vision cycle. The visual system is able to adapt to a very wide range of luminous intensities. Following the exposure to a bright light the retina becomes less sensitive to light, corresponding to the “destruction” of the visual pigments (rhodopsin, in the case of the rods). If after that the subject spends a period of time in a dark environment, the retina slowly regains sensitivity to light, a process known as Dark Adaptation (DA) that corresponds to the regeneration of the photopigments. The rhodopsin regeneration can be measured with a psychophysical technique, using a light source of variable intensity and establishing the minimum visible light threshold at each few seconds, following the exposure to the bleaching field. This procedure is known as a Dark Adaptation Test.

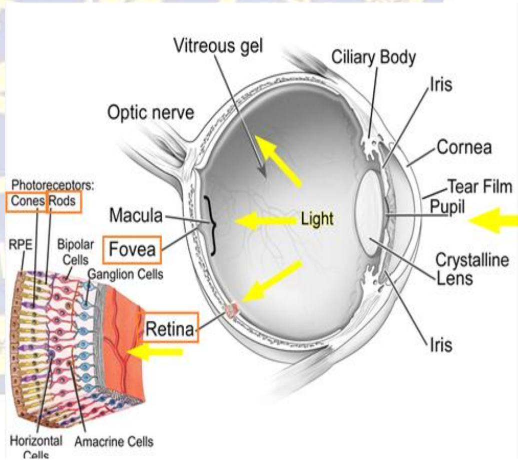


Definition

Dark adaptation (DA) is the physiological process by which the retina gradually restores its sensitivity to low-light conditions following exposure to bright illumination. This process is essential for visual performance in dim environments, such as entering a darkened room after being outdoors or driving into a tunnel on a sunny day. As adaptation progresses, the eye's threshold for detecting light decreases, allowing for improved vision in the dark.

Dark adaptometry can be performed using chromatic stimuli to distinguish rod and cone contributions. Red light (~650 nm) preferentially stimulates cones, while blue–green light (~500 nm) targets rods. Deviations in the shape or timing of the DA curve, such as delayed rod–cone break or incomplete recovery, may indicate early dysfunction in diseases like age-related macular degeneration (AMD), retinitis pigmentosa (RP), or vitamin A deficiency.





Indication:

While long established, dark adaptometry is gaining renewed attention as a practical diagnostic tool for a wide range of retinal disorders, including:

- age-related macular degeneration (AMD)

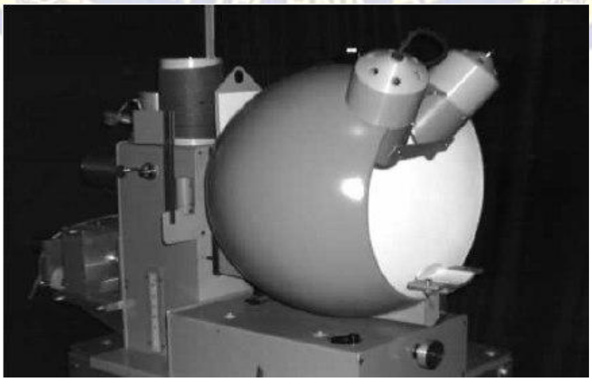
- diabetic retinopathy
- vitamin A deficiency (VAD) retinopathy.
- congenital retinal disorders and night blindness.

advantages of dark adaptometry

is its ability to detect early retinal dysfunction, often before any structural changes become apparent. This makes it a useful tool for early diagnosis and management in clinical practice.

Instruments:

Dark adaptation threshold tests are usually measured with Goldmann-Weekers Adaptometers in ophthalmologic clinics. After a brief preadaptation period, the subject looks into the center of a white sphere. A bright light (bleaching light), is projected in this apparatus to cause depletion of the photopigments, making the retina less sensitive to light. Next, during dark adaptation, a circular stimulus field with 11 degrees of arc is presented centrally at a distance of 30 cm. Figure 1 below shows the apparatus used in a traditional Goldmann-Weekers dark adaptometer. Goldmann-Weekers dark adaptometer.



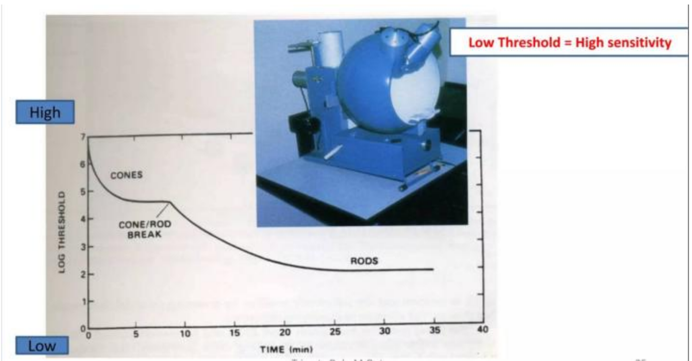
The Goldmann-Weekers dark adaptometer has several limitations. Some of the problems with this dark adaptometer are related to the operation of equipment: the dark adaptation threshold is determined by manually decreasing (or increasing) the light intensity of the stimulus, until the subject perceives the light. Three qualified people are needed to run tests on patients. All test data, calculations and plots are manually recorded

procedure:

1. The testing procedure and requirements are fully explained to the patient
2. The patient will sit with their chin on a chinrest while looking into the dark adaptation machine.
3. The patient is instructed to fixate at a bright light source for about 3 min in order to bleach at least 80% of rhodopsin, the visual pigment of the rod photoreceptors Cones' visual pigments is bleached too but to a lesser extent. Following the bleaching exposure, a subtle bright light will blink and the patient will hit a button when they see that light. The light will flash at different intensities to test the threshold of the patient's rod function.
4. The test takes about 30-40 minutes to complete and should be performed in a dark room.

The Sensitivity Curve and Its Components

This curve represents the relationship between the logarithm of retinal sensitivity to light (Y-axis) and time (X-axis). The normal curve shows two distinct features:



1. The Cone Branch:

First Phase: Immediately after bright light exposure, sensitivity is very low. A rapid, early improvement in sensitivity occurs within the first 5-7 minutes. this phase is primarily due to the adaptation of the cones, which are responsible for central and color vision in bright light.

2. The Rod-Cone Break:

After about 7-10 minutes, the rate of sensitivity improvement suddenly slows, forming a clear "break" or "kink" in the curve. This point represents the moment when rod sensitivity surpasses cone sensitivity. After this point, the rod system becomes dominant in the adaptation process.

3. The Rod Branch:

Second Phase: After the rod-cone break, sensitivity continues to improve but at a slower rate. This phase has a smooth curve and continues until it reaches a plateau, which is the maximum sensitivity the retina can achieve (the final threshold). This phase is due to the replenishment of rhodopsin in the rods, which are responsible for peripheral and night vision.

introduction:

Orthoptics, from Greek "orthos" (straight) and "optikos" (vision), is dedicated to diagnosis and treatment of binocular vision disorders, aiming to restore or improve Simple Binocular Vision (SBV). SBV is a coordinated sensorimotor process creating a single, unified, three-dimensional image. Rehabilitation of SBV in congenital or acquired strabismus depends on precise diagnosis. Specialized instruments, as extensions of clinical expertise, assess sensory system (retinal correspondence, fusion), motor system (alignment, motility), and inhibiting factors (suppression, amblyopia).

Procedures of orthoptics training

The base of diagnosis and indications of orthoptics training is precise examination of patient's visual function (visual acuity, cover test, test of eye motility etc.). In case of positive diagnosis ophthalmologist/orthoptist suggests procedures of treatment, which depends on degree of SBV development and age of child. Really important is child's motivation to training, which makes treatment much easier and effective. Training should be performed with optimal spectacle correction. Procedures of orthoptics training are these:

- training of superposition
- Training of fusion
- Training of stereopsis
- Training of eye motility
- Training of convergence
- Training of relationship between accommodation and convergence

Haploscope

A haploscope is an optical instrument for orthoptic examinations presenting different image to each eye, used for diagnosis and therapy of binocular vision, stereopsis, and strabismus. Examples are Synoptophore and Worth's amblyoscope. Uses include

- Measuring deviations (subjective and objective angle).
- Assessing binocular vision (grades, fusion, stereopsis).
- Diagnosing suppression (presence or absence).

Orthoptics instruments

All of orthoptics instruments are based on dissociation of both eyes perception. We create virtual infinity with help of the instrument. But there are psychological proximity reactions, which could negatively influence the perception of infinity.

1. Troposcope/Synoptophore

synoptophore is the most used instrument for diagnosis and treatment of SBV disorders. Based on Wheaston's stereoscope and Worth's amblyoscope, the name synoptophore is common in Great Britain. Modern types use mechanical and electrical principles. The instrument, based on haploscopy, presents each eye its own image perception. Uses include

- diagnosis of degrees of SBV.
- elimination of suppression.
- improvement of fusion and stereo vision.
- treatment of ARC and eccentric fixation.

2. Cheiroscope stereoscope

This instrument is the second most used for orthoptics to overcome and train superposition. Cheiroscope uses special mirror with horizontal desktop and vertical pattern pictures. One eye watches pattern picture, the other eye desktop through plus 8 diopters lenses. Mirror at 45 degrees divides space. Patient traces picture requiring cooperation of both eyes.

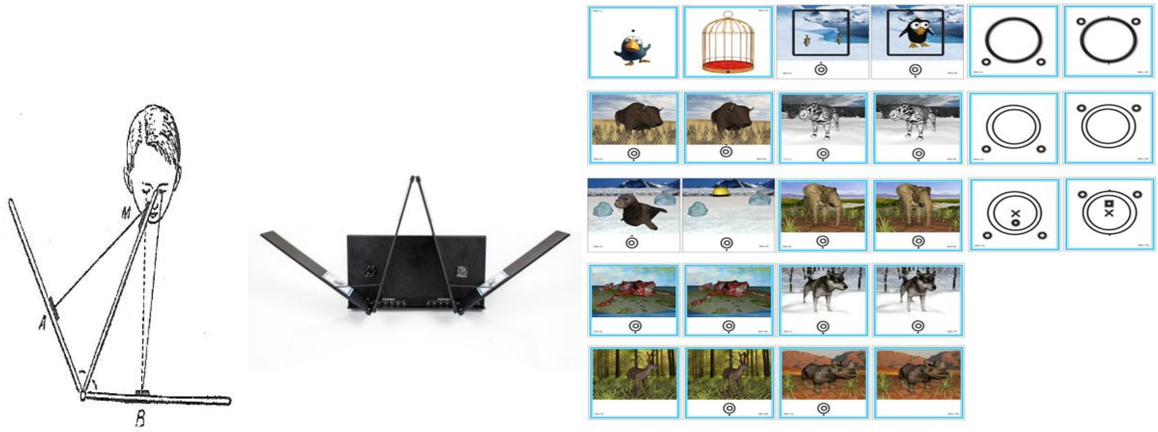
Examiner controls cooperation by watching eye with mirror, comparison of painted picture with pattern, and control of oculars. If child draws by memory, fixation is alternating, picture bigger or smaller with shift in direction of deviation. With youngest children, soft transparent paper is recommended.

Hunt of cheiroscope can be used with moving pattern and patient hunts with net on desktop.

Drawing on cheiroscope --- Hunt of cheiroscope

3. Mirror stereoscope

Mirror stereoscope is used for breaking suppression, training of superposition and fusion. Instrument has two main parts like cheiroscope, divided by mechanical septum covered by mirror, set in right or left position. Mirror dissociation brings real sensation of space. Patient watches pattern with one eye and drawing part of board with other eye. Patient can draw pattern or catch butterfly by “hunt on stereoscope”. Board can be set horizontal (180 degrees) or vertical (135 degrees). Training results controlled by orthoptist with scale on board.



Mirror stereoscope

4. Brewster – Holmes stereoscope

This instrument allows training of fusion, width of fusion, and stereo vision. It is composed of horizontal lath with carriers of pictures and two decentered lenses (5 diopters, temporal basis, prismatic effect). Mechanical septum is in the middle. Distance of picture is invariable. Pictures for fusion or stereo vision are placed in carriers to find location for possible fusion. Fusion is controlled by special marks. Width of fusion trained by moving picture to divergence (negative fusion) and convergence (positive fusion). Stereoscopy training uses special stereoscopy pictures with control marks.

Brewster-Holmes stereoscope

5. Vergence stereoscope

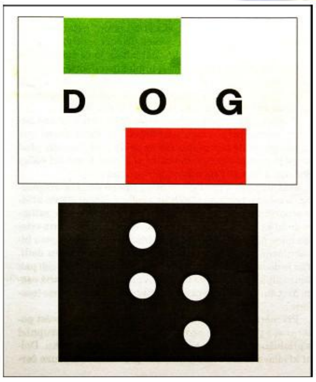
This instrument is used in the same way like Brewster-Holmes stereoscope (fusion, fusion width and stereopsis). The difference is in possibility of changing distance between pictures.

6. Remy's separator

Remy's separator is a mechanical instrument used for relaxation of accommodation and convergence and for training their relationship. Partial dissociation in real space is reached with 30 cm long lath placed to nose root. On other side is transparent plastic film to see distance. Patient resting on septum looks through slides at object beyond. If both eyes focus on retina, superimposed picture is seen by patient.

7. Remy's diplocope

Remy’s diploscope is an instrument for assessing and training binocular vision and muscle balance, invented by Albert Remy around 1901. It has a septum with multiple apertures to view test cards with letters and colored squares, such as "DOG", to detect suppression, amblyopia, and squint-related conditions. The septum separates images for each eye. Testing binocular vision with card "DOG" shows simultaneous binocular vision. If only "DO" or "OG" is seen, it indicates suppression.



Normal position of eyes:

Right eye Left eye

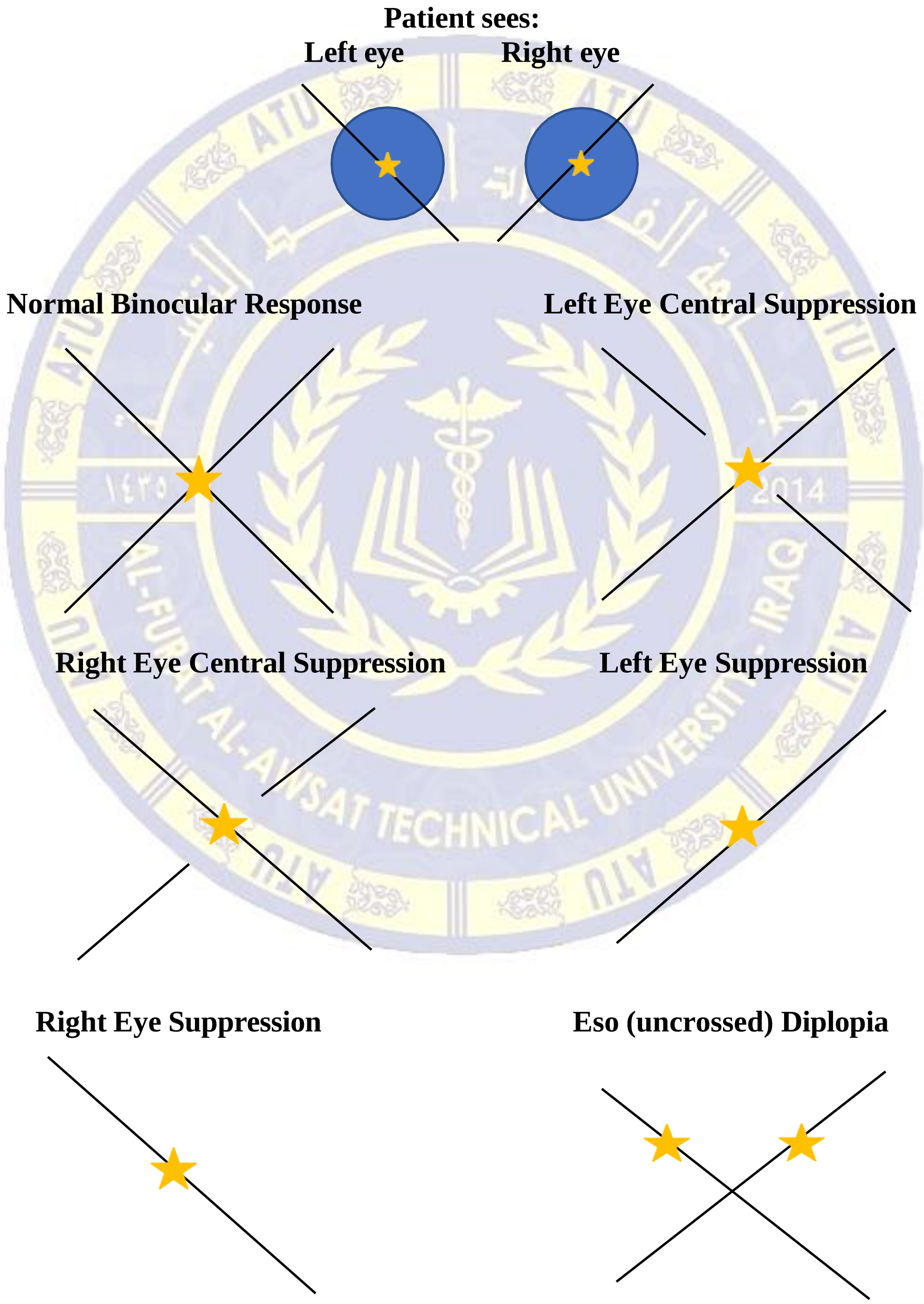
Bagolini striated glasses

These glasses are mounted in a frame for use in a trial frame for testing retinal correspondence. Place two lenses, one in front of each eye at 45° and 135°. Patient fixates on bright point light from 6m (distance) or 40 cm (near). Ask about orientation of lines seen through glasses and with one eye covered.

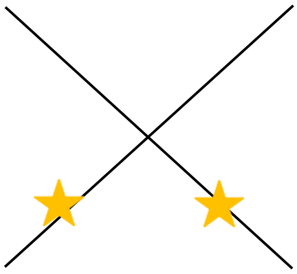
Results:

- perfect cross through light and no deviation indicates NRC
- manifest squint shows variant results
- perfect cross with deviation on cover test indicates harmonious ARC

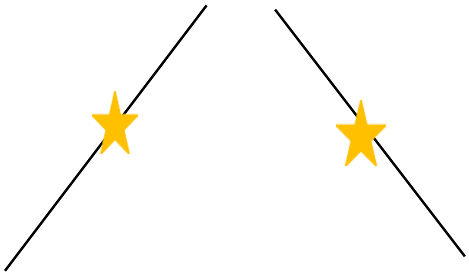
- cross with one line not through central light indicates unharmonious ARC or suppression with NRC
- single line indicates complete suppression towards non-suppressed eye
- two lines from two lights not crossing indicate diplopia without suppression in NRC.



Exo (crossed) Diplopia



Exo and Left Hyper Diplopia



Large Eso Diplopia

Large Exo Diplopia

Advantages

- Simple and easy test
- No requirement of expensive equipment
- Eyes are not dissociated, hence resembles with normal conditions during testing.
- Testing can be done for both near and distance vision.

Disadvantages

- Test results are only qualitative. Quantitative analysis (measurement of angle of deviation) is not done.
- Small degree of deviation is not assessed because it gets unnoticed.

introduction:

Orthoptics, from Greek "orthos" (straight) and "optikos" (vision), is dedicated to diagnosis and treatment of binocular vision disorders, aiming to restore or improve Simple Binocular Vision (SBV). SBV is a coordinated sensorimotor process creating a single, unified, three-dimensional image. Rehabilitation of SBV in congenital or acquired strabismus depends on precise diagnosis. Specialized instruments, as extensions of clinical expertise, assess sensory system (retinal correspondence, fusion), motor system (alignment, motility), and inhibiting factors (suppression, amblyopia).

Procedures of orthoptics training

The base of diagnosis and indications of orthoptics training is precise examination of patient's visual function (visual acuity, cover test, test of eye motility etc.). In case of positive diagnosis ophthalmologist/orthoptist suggests procedures of treatment, which depends on degree of SBV development and age of child. Really important is child's motivation to training, which makes treatment much easier and effective. Training should be performed with optimal spectacle correction. Procedures of orthoptics training are these:

- training of superposition
- Training of fusion
- Training of stereopsis
- Training of eye motility
- Training of convergence
- Training of relationship between accommodation and convergence

Haploscope

A haploscope is an optical instrument for orthoptic examinations presenting different image to each eye, used for diagnosis and therapy of binocular vision, stereopsis, and strabismus. Examples are Synoptophore and Worth's amblyoscope. Uses include

- Measuring deviations (subjective and objective angle).
- Assessing binocular vision (grades, fusion, stereopsis).
- Diagnosing suppression (presence or absence).

Orthoptics instruments

All of orthoptics instruments are based on dissociation of both eyes perception. We create virtual infinity with help of the instrument. But there are psychological proximity reactions, which could negatively influence the perception of infinity.

1. Troposcope/Synoptophore

synoptophore is the most used instrument for diagnosis and treatment of SBV disorders. Based on Wheaston’s stereoscope and Worth’s amblyoscope, the name synoptophore is common in Great Britain. Modern types use mechanical and electrical principles. The instrument, based on haploscopy, presents each eye its own image perception. Uses include

- diagnosis of degrees of SBV.
- elimination of suppression.
- improvement of fusion and stereo vision.
- treatment of ARC and eccentric fixation.

2. Cheiroscope stereoscope

This instrument is the second most used for orthoptics to overcome and train superposition. Cheiroscope uses special mirror with horizontal desktop and vertical pattern pictures. One eye watches pattern picture, the other eye desktop through plus 8 diopters lenses. Mirror at 45 degrees divides space. Patient traces picture requiring cooperation of both eyes.

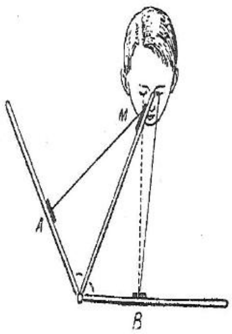
Examiner controls cooperation by watching eye with mirror, comparison of painted picture with pattern, and control of oculars. If child draws by memory, fixation is alternating, picture bigger or smaller with shift in direction of deviation. With youngest children, soft transparent paper is recommended.

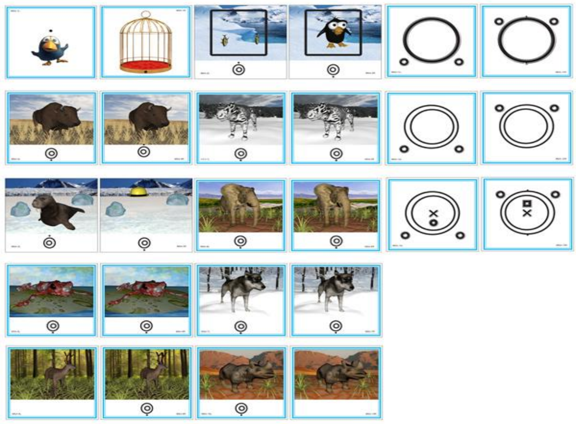
Hunt of cheiroscope can be used with moving pattern and patient hunts with net on desktop.

Drawing on cheiroscope --- Hunt of cheiroscope

3. Mirror stereoscope

Mirror stereoscope is used for breaking suppression, training of superposition and fusion. Instrument has two main parts like cheiroscope, divided by mechanical septum covered by mirror, set in right or left position. Mirror dissociation brings real sensation of space. Patient watches pattern with one eye and drawing part of board with other eye. Patient can draw pattern or catch butterfly by “hunt on stereoscope”. Board can be set horizontal (180 degrees) or vertical (135 degrees). Training results controlled by orthoptist with scale on board.



Mirror stereoscope

4. Brewster – Holmes stereoscope

This instrument allows training of fusion, width of fusion, and stereo vision. It is composed of horizontal lath with carriers of pictures and two decentered lenses (5 diopters, temporal basis, prismatic effect). Mechanical septum is in the middle. Distance of picture is invariable. Pictures for fusion or stereo vision are placed in carriers to find location for possible fusion. Fusion is controlled by special marks. Width of fusion trained by moving picture to divergence (negative fusion) and convergence (positive fusion). Stereoscopy training uses special stereoscopy pictures with control marks.


Brewster-Holmes stereoscope

5. Vergence stereoscope

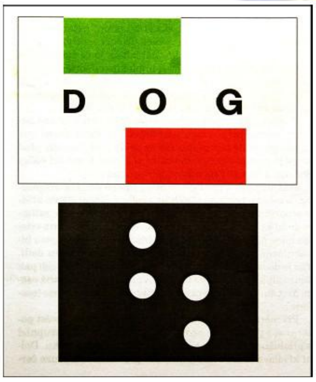
This instrument is used in the same way like Brewster-Holmes stereoscope (fusion, fusion width and stereopsis). The difference is in possibility of changing distance between pictures.

6. Remy's separator

Remy's separator is a mechanical instrument used for relaxation of accommodation and convergence and for training their relationship. Partial dissociation in real space is reached with 30 cm long lath placed to nose root. On other side is transparent plastic film to see distance. Patient resting on septum looks through slides at object beyond. If both eyes focus on retina, superimposed picture is seen by patient.

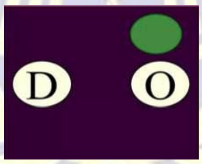
7. Remy's diplocope

Remy's diploscope is an instrument for assessing and training binocular vision and muscle balance, invented by Albert Remy around 1901. It has a septum with multiple apertures to view test cards with letters and colored squares, such as "DOG", to detect suppression, amblyopia, and squint-related conditions. The septum separates images for each eye. Testing binocular vision with card "DOG" shows simultaneous binocular vision. If only "DO" or "OG" is seen, it indicates suppression.



Normal position of eyes:

Right eye



Left eye

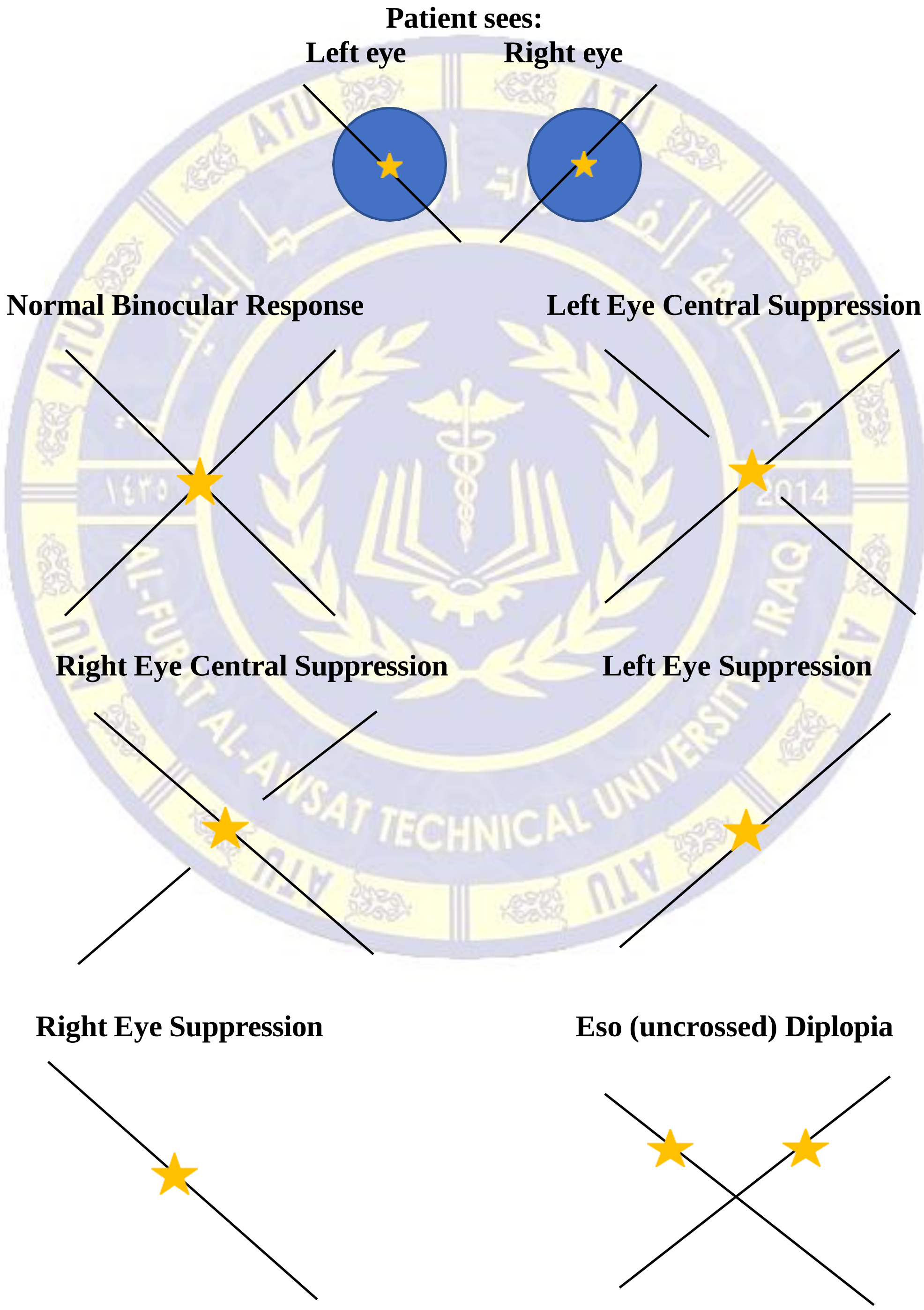
Bagolini striated glasses

These glasses are mounted in a frame for use in a trial frame for testing retinal correspondence. Place two lenses, one in front of each eye at 45° and 135°. Patient fixates on bright point light from 6m (distance) or 40 cm (near). Ask about orientation of lines seen through glasses and with one eye covered.

Results:

- perfect cross through light and no deviation indicates NRC
- manifest squint shows variant results
- perfect cross with deviation on cover test indicates harmonious ARC

- cross with one line not through central light indicates unharmonious ARC or suppression with NRC
- single line indicates complete suppression towards non-suppressed eye
- two lines from two lights not crossing indicate diplopia without suppression in NRC.



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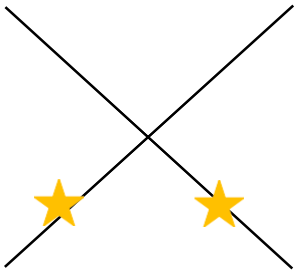

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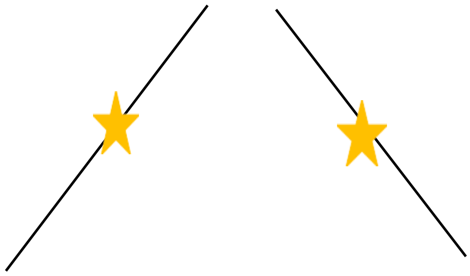

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