The ministry of health of the Republic of Belarus

Educational institution «Gomel State Medical University»

Department of Otorhinolaryngology with a course of ophthalmology

Discussed at the meeting
department
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MANUALS

for 5th year students of faculty of foreign students on ophthalmology

TOPIC №2. Visual function and age dynamics of their development. Methods of examination in ophthalmology.

The time 6 hours

Gomel, 2025

MOTIVATION FOR LEARNING TOPICS, TRAINING AND EDUCATIONAL PURPOSES, THE REQUIREMENTS TO THE ORIGINAL LEVEL OF KNOWLEDGE.

Visual capacity of the central nervous system in humans progressively develops from the birth. The occi pital region of the human brain has a specific area for receiving and interpreting images captured by eyes. Optic nerve fiber myelination progresses to completion in the tenth week after birth and consequently rapidly increases the synaptic density of the visual cortex from birth to four months of extrauterine life, reflecting in improved visual perception, fixation, and functional coordination of accompanying motivators of visual stimuli.

Development of the visual system immediately starts after birth via visual stimuli and interactions with the environment, which concomitantly occur with the child's global development, i.e., neuropsychomotor development, visual-motor coordination, cognitive abilities, and behavioral, environmental, and sociocultural adaptation. The anatomical and neurophysiological integrity of this system is essential for the occurrence of the maturation process, which differs with age and is interdependent of genetic, cognitive, and environmental aspects.

The ophthalmic examination requires detection of abnormal structure and function. Vision, the ability to see, the fundamental function of the eyes wich can be assessed in various ways. This topic will introduce the theory, practice and understanding of ophthalmology investigations and examination techniques. It will provide the knowledge and training of ophthalmologic procedures for the examination, diagnosis and treatment of visual and ocular conditions usingt best-practice methodology.

The purpose of the class: To study the physiology of visual perception, the pathology of visual functions: central, peripheral vision, color perception, light perception and binocular vision. Master the methods of research of visual functions – visometry; perimetry, color perception, nature of vision. To study external examination of the eye and its adnexa. Features of the external examination of the eyes in newborns and young children. Study of the anterior part of the eye under normal lighting, training in examination with transmitted light, ophthalmoscopy, biomicroscopy, tonometry.

Objectives of the lesson:

Student should know:

1. Pathology of visual functions: central, peripheral vision, color perception, light perception and binocular vision;
2. Modern methods for the study of visual functions: determination of visual acuity according to Snellen's formula;
3. The principle of the device tables for checking visual acuity.
4. The study of visual acuity in children;
5. Definition of visual fields: perimetry - kinetic and static, control method for determining visual fields;
6. Defects in the field of view - narrowing of borders, hemianopsia, scotomas;

7. Violation of color perception: types of congenital and acquired color vision disorders, their frequency;
8. The role of heredity;
9. Research methods for color vision; dark adaptation study;
10. Congenital, essential, symptomatic hemeralopia; its connection with the general condition of the body; study of the nature of vision;
11. Conditions for the formation of binocular vision, the causes of binocular vision disorder.
12. The method of research of the anterior eye in direct light.
13. The physical laws underlying the focal illumination method (ray concentration, contrast phenomenon).
14. The technique of researching the anterior part of the eye using focal illumination and the bifocal method, a binocular magnifier.
15. Principles of a slit lamp device, methods of operation on this device.
16. Advantages and disadvantages of the focal illumination method compared to inspection under diffuse lighting.
17. Methods of studying the environments of the eye in transmitted light. Differential diagnosis between opacities of the cornea, lens, vitreous.
18. Principles and methods of ophthalmoscopy in reverse and direct form. Picture of the normal fundus.

***Student must be able to*:**

1. Determine visual acuity;
2. Explore visual fields in white, red and green colors;
3. Determine the pathology of color perception according to Rabkin tables;
4. Determine the nature of vision in the color test.
5. Examination of the eyelids, examination of the lacrimal organs, palpation of the orbit, inversion of the eyelids and examination of the conjunctiva.
6. Inspection of the anterior eyeball, determining the mobility of the eye.
7. Determination of the tone of the eyeball by palpation,
8. Inspection of the anterior segment of the eyeball by biomicroscopy.
9. Examination of the fundus by ophthalmoscopy.

The student must perform the following practical skills:

1. Visometry;
2. Perimetry;
3. Study of color perception;
4. Determination of the nature of vision.
5. Methods of fixing a small child for eye examination;
6. Eversion of the upper eyelid to examine the mucous membrane of the eye;
7. Study of the mobility of the eyeballs;
8. Determination of the presence of contents in a tear bag;
9. Fundus examination using direct and reverse ophthalmoscopy;
10. Study of optical media in transmitted light.

CHECKLIST OF QUESTIONS FROM RELATED SUBJECTS

1. Physiology of visual perception.
2. Physiology of color perception.
3. External examination of the patient
4. Methods of palpation

CHECKLIST OF CONTROL QUESTIONS FOR THE LESSON

1. Physiology of visual perception.
2. Pathology of visual functions: central, peripheral vision, color perception, light perception and binocular vision. Basic principles for the diagnosis of visual impairment.
3. Modern research methods of visual functions.
4. Visual acuity as a function of the macula.
5. Determination of visual acuity by Snellen's formula. The principle of the device tables for checking visual acuity. The study of visual acuity in children.
6. Peripheral vision as a function of the paracentral and peripheral departments of vision. Kinetic and static perimetry, a control method for determining visual fields.
7. Defects in the field of view - narrowing of borders, hemianopsia, scotomas.
8. Types of congenital and acquired color vision disorders, their frequency. The role of heredity. Research methods for color vision. Isopolychromatic tables by E.B.Rabkin and principles of their construction. The role of color vision research for the diagnosis of damage to various parts of the organ of vision.
9. Research methods for dark adaptation. Congenital, essential, symptomatic hemeralopia; its connection with the general condition of the body.
10. Conditions for the formation of binocular vision, the causes of binocular vision disorder, research methods.
11. The procedure for examining a patient with eye diseases.
12. The main methods of examination of the organ of vision.
13. External examination of the eye and its adnexa. Features of external examination in newborns and young children.
14. Ophthalmotonometry.
15. Methods of side and focal lighting. The technique of simple and combined side lighting. Study in transmitted light. Examination of the lens and vitreous body.
16. Biomicroscopy. The importance of biomicroscopy for the diagnosis and monitoring of eye diseases.
17. Ophthalmoscopy. The study of the retina, choroid, optic disc.
18. Echobiometry.

PRACTICAL PART OF THE LESSON

Work of students is carried out in the ophthalmology department in the presence of the teacher of the department in order to develop and consolidate practical skills. The acquired skills are consolidated in the training room when examining patients or at a seminar. In the classroom, students independently study modern clinical protocols for examination and treatment, methodological recommendations of the ministry of health of the Republic of Belarus.

The control of the final level of knowledge is carried out at a seminar or in the clinical analysis of a patient, an outpatient card or a medical card.

1. Analysis of the thematic patient.
2. Clinical analysis of outpatient cards, medical records.
3. Answers to questions of a computer test program in ophthalmology on the topic «Visual function and age dynamics of their development»
4. The procedure for examining a patient with eye diseases.
5. The main methods of examination of the organ of vision.
6. External examination of the eye and its adnexa. Features of external examination in newborns and young children.
7. Ophthalmotonometry.

QUESTIONS FOR SELF STUDY AND ADDITIONAL RESEARCH TASKS

1. Physiology of visual perception.
2. Pathology of visual functions: central, peripheral vision, color perception, light perception and binocular vision.
3. Basic principles for the diagnosis of visual impairment.
4. Modern methods for the study of visual functions.
5. Methods of side or focal lighting. The technique of simple and combined side lighting. Study in transmitted light. Examination of the lens and vitreous body.
6. Biomicroscopy. The importance of biomicroscopy for the diagnosis and monitoring of eye diseases.
7. Ophthalmoscopy. The study of the retina, choroid, optic disc.
8. Echobiometry.
9. Development of practical skills on the methods of studying visual functions - visometry; perimetry, color perception, nature of vision.

INTRODUCTION

The complete assessment of an individual’s vision-related abilities requires the consideration and characterization of both visual function and functional vision, particularly in the case of visual impairment. Visual function describes how well the eyes and basic visual system can detect a target stimulus. By varying a single parameter at a time (for example, the size of the target), testing is typically carried out in a repeated fashion under controlled testing conditions until a threshold of performance is obtained. In

contrast, functional vision refers to how well an individual performs while interacting with the visual environment. That is to say, how their vision is used in everyday activities. Characterizing functional vision involves the assessment of multiple and varying parameters captured under complex, real-life conditions. In this instance, how well an individual is able to sustain performance is a crucial factor. The concepts of visual function and functional vision are certainly linked and assessing one can often provide useful information regarding the other. For example, if an individual shows evidence of impaired visual functioning (e.g. reduced acuity), one may predict potential impairments with certain visual tasks (e.g. reading) and possible strategies to help remediate the situation (such as magnification or large print). Observing a patient's functional visual behaviors in the environment (e.g. trouble descending a flight of stairs) can signal which test of visual function should be carried out in the formal clinical setting (e.g. contrast sensitivity, visual field perimetry), or help identify modifications needed to ensure accurate assessment.

It is important to recognize however, that there are situations where an individual's visual function may be assessed as "within normal range", yet their functional vision is still clearly impaired. This disconnect is often evident in the setting of evaluating visual performance in pediatric and adolescent populations with early developmental brain damage, particularly in the case of brain based visual impairment such as cerebral (or cortical) visual impairment (CVI). If comprehensive assessments and careful consideration of both visual function and functional vision are not carried out, individuals with visual cognitive and higher order perceptual impairments may not be able to secure needed services if determinations are based on visual function measures alone such as visual acuity. Furthermore, the necessity to accurately characterize visual function and functional vision performance is crucial in order to generate an appropriate management plan that best suits the needs and developmental goals of an individual [7].

Visual acuity.

Testing visual acuity is a simple procedure based on fairly complex optical principles. The test demonstrates how well an eye distinguishes the size and shape of objects in the visual axis. The normal visual axis is composed of clear media (cornea, aqueous, lens, and vitreous) that focus light rays on the retinal fovea. Images that fall on the fovea and peripheral retina are then processed by the nervous system to produce the sense we know as vision.

The visual angle is defined as the angle that an object's outermost rays subtend on the retina and is measured in degrees or minutes of arc. At a given distance, a larger object subtends a larger angle; the same object subtends a larger angle when it is closer to the eye. The details of an o1bject are what make it identifiable. For instance, an "E" and an "H" would look the same if the details within the outermost boundaries were not resolvable by the eye. An eye can resolve the details of an object when it can distinguish spatially separated parts of that object. The minimum angle resolvable by the normal human eye is about 1 minutes (min) of arc.

Distant and near visual acuity should be tested separately. Visual acuity is examined one eye at a time, the other eye being occluded. By convention, the right eye is tested first. Pressure on the occluded eye should be avoided so that there will be no distortion of the image when that eye is subsequently tested. On the initial exam, the test should be made

both with and without corrected lenses (if used) and recorded. On subsequent visits, glasses are worn for the test [3,4].

- Distant visual acuity.

The chart most commonly used for distance vision with literate patients is the Snellen chart and chart Golovina-Sivceva, which is situated 20 ft (6 m) away for Snellen chart and 5m for Golovina-Sivceva chart from the patient and diffusely illuminated without glare. At this distance, the rays of light from the object in view are almost parallel, and no effort of accommodation (focusing) is necessary for the normal eye to see the subject clearly. The charts are composed of letters of graduated sizes; the distance at which each size subtends an angle of 5 minutes of arc is indicated along the side of the chart. The farther one is from an object, the smaller the retinal image. By combining the two factors of size and distance, it is possible to determine the minimum visual angle (the smallest retinal image that can be seen by a given eye). A normal visual system can identify an entire letter subtending an angle of 5 minutes of arc and any components of the letter subtending 1 minute of arc at a distance of 20 ft. Some patients, however, may resolve letters subtending even smaller visual angles.

Worldwide, Snellen charts are the most popular charts for vision measurement, with many variations using a range of optotypes. For testing vision in children, the Landolt C chart, the Tumbling E chart, Lea Symbols, Lea grating, or other tests may be employed. The choice of chart varies depending on patient requirement, practitioner preference, testing method, resource availability, and staff expertise [3].

Procedure of testing. For testing distant visual acuity, the patient is seated at a distance of 6m from the chart, so that the rays of light are practically parallel and the patient exerts minimal accommodation. The chart should be properly illuminated (not less than 20 ft candles). The patient is asked to read the chart with each eye separately and the visual acuity is recorded as a fraction, the numerator being the distance of the patient from the letters, and the denominator being the smallest letters accurately read. When the patient is able to read up to 6 m line, the visual acuity is recorded as 6/6, which is normal.

The vision is recorded as a fraction. The number in the numerator position is the equivalent of the testing distance from the eye to the chart in feet or meters. The number in the denominator position is the distance at which a subject with normal vision can read the same figure. The vision of a normal eye is therefore recorded as 20/20, or 6/6 in metric measurement or 1.0. If the patient is able to read down only to the 20/30 line, the vision is recorded as 20/30.

logMAR for routine use [5].

logMAR charts are differ in the use of optotypes, number of optotypes in a row, or number of lines in a chart. The use of logMAR charts with standard methods is expected to cause some test-retest variability based on the use of optotypes, number of lines, illumination, and other factors, but is a considerable improvement over using the Snellen chart. This method can reduce testing time and is much less cumbersome to use than the standard research protocol. Though using the compact logMAR chart takes a slightly longer time than using the Snellen chart (5-40 sec vs 3-35 sec), the time taken was almost half that taken for using the standart chart (9-80 sec). The difference in sensitivity and specificity of simplified logMAR compared to the standard is marginal (95 % vs 98%). Training school teachers in the use of simplified logMAR charts was accomplished in half

a day and the only logistics required for screening were a pen, a measuring tape, and the chart itself. Thus, from a practical standpoint, using logMAR charts with standard methods would be an excellent compromise (Fig 1).

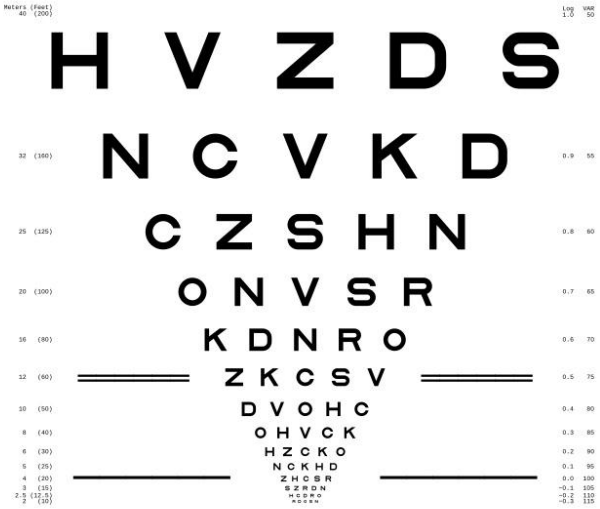


Fig 1. logMAR chart

Binocular vision.

Binocular vision is one of the hallmarks of the human race that has bestowed on it the supremacy in the hierarchy of the animal kingdom. It is an asset with normal alignment of the two eyes, but becomes a liability when the alignment is lost.

Binocular Single Vision may be defined as the state of simultaneous vision, which is achieved by the coordinated use of both eyes, so that separate and slightly dissimilar images arising in each eye are appreciated as a single image by the process of fusion. Thus binocular vision implies fusion, the blending of sight from the two eyes to form a single percept.

Binocular Single Vision can be:

1. Normal – Binocular Single vision can be classified as normal when it is bifoveal and there is no manifest deviation.

2. Anomalous - Binocular Single vision is anomalous when the images of the fixated object are projected from the fovea of one eye and an extrafoveal area of the other eye i.e. when the visual direction of the retinal elements has changed. A small manifest strabismus is therefore always present in anomalous Binocular Single vision.

Normal Binocular Single vision requires:

1. Clear Visual Axis leading to a reasonably clear vision in both eyes

2. The ability of the retino-cortical elements to function in association with each other to promote the fusion of two slightly dissimilar images i.e. Sensory fusion.

3. The precise co-ordination of the two eyes for all direction of gazes, so that corresponding retino-cortical element are placed in a position to deal with two images i.e. Motor fusion.

The advantages of a Binocular vision are:

1. The first and the foremost advantage of a binocular vision is single vision.

2. In addition to single vision it results in stereopsis – the most precise kind of depth perception

3. Enlargement of the field of vision

4. Compensation for blind spot and other differences

Visual Axis (Line of direction or direction ray of Helmholtz)

It is the line which connects an object point with its image on the retina. If the visual axis of the two foveas also known as the principle visual axis intersects at the fixation point, it is said that there is binocular fixation. If only one principle line of direction goes through the fixation point, then fixation is monocular. All object points that simultaneously stimulates the two fovea appears in one and the same subjective visual direction coinciding with the median plane of the head. This is known as the common subjective visual direction of the fovea. It lies in as imaginary plane passing through the root of the nose known as third central imaginary eye or the binoculus or cyclopean eye.

Retinal elements of the two eyes that share a common subjective visual direction are called corresponding retinal points. All other retinal elements are non-corresponding or disparate with respect to a given retinal element in the fellow eye for a particular visual direction.

Law of Sensory Correspondence

It states that existence of corresponding retinal elements with their common relative subjective visual direction is the essence of binocular vision.

Retinal Correspondence can be of two types:

1. Normal Retinal Correspondence

Retinal correspondence is called normal when both the fovea have a common visual direction and the retinal elements nasal to the fovea in one eye corresponds to the retinal elements temporal to the fovea in the other eye.

2. Abnormal Retinal Correspondence

Retinal correspondence is abnormal when the fovea of one eye has a common visual direction with an extrafoveal area in the other eye. This is generally seen if the angle of squint is small and the extrafoveal point is close to the fovea. It is an attempt to regain the binocular advantage, although anomalous (because it is foveo-extrafoveal and not foveofoveal).

This results in the eyes seeing binocularly single inspite of a manifest squint. In ARC under binocular conditions the fovea and the extafoveal point share the common subjective visual direction. But when the normal eye is closed the extrafoveal element loses any advantage over the fovea of that eye, which retains its primary visual direction.

Thus under monocular conditions the central fixation is retained by the fovea, this is the basis of the cover test.

DEVELOPMENT OF BINOCULAR VISION

Humans and many other animals have two forward facing eyes and a large overlap between their visual fields. One of the major benefits of this is stereopsis: integration of the slightly different viewpoints of the two eyes (binocular disparity) results in tangible subjective sensation of three-dimensional visual space, and accurate coding of depth. Binocular disparity improves eye-hand coordination, and visual recognition of singular items when simple stimulus displays are used. Whether disparity also improves the segmentation of objects from background in naturalistic settings where multiple objects are present remains open [6].

During the first few years of life certain normal anatomical and physiological conditions are required for the development of binocular vision. The factors concerned in

the development of binocular vision and which enable the eyes to function in a coordinated manner are:

A) Anatomical factors: The two eyes are so situated in the orbit that the visual axis is directed in the same direction. This is due to: shape of the orbit and presence of adjacent ligaments, muscles and connective tissues. The extra-ocular muscles have an important role to play as they provide motor correspondence because of the reciprocal innervation of the extra-ocular muscles.

The aim of the motor correspondence is to-enlarge the field of view by transforming the field of vision into the field of fixation. Bring back the object of attention on to the fovea and to maintain it. Position the two eyes in such a way that at all the times they are properly aligned.

B) Physiological factors: The development of binocular vision (BV) depends upon certain normal physiological binocular reflexes. The reflexes can either be inborn or acquired as a result of appropriate stimulation. The various binocular reflexes

At birth the fixation reflex is poorly developed, with the child having only random, nonconjugate and aimless ocular movements. There is inability to carry out pursuit movements during the first few weeks of life. The development of optomotor reflex is essentially a post natal event, with the approximate time schedule being : 2- 3 weeks – follows light uniocularly, 6 weeks to 6 months - follows light binocularly.

Convergence which is absent at birth starts developing at 1 month of age and is well established by 6 months. The development of accommodation lags behind the development of convergence due to the delay in the development of ciliary muscles, parallels with the convergence by 6 months of age.

TEST FOR RETINAL CORRESPONDENCE

Worth Four Dot Test: This is a simple test utilizing red-green color dissociation. It is more dissociating than the bagolini glasses and so less physiological. The apparatus for this test consists of a box containing four panes of glass, arranged in diamond formation, which are illuminated internally. The two internal panes are green, the upper one is red and lower one is white. The patient wears red and green goggles (as a convention red in front of right and green in front of left). The test can be performed separately for distance and near vision. The interpretation of this test is as follows-

a) Prior to use of glasses.

b) The patient sees all the four dots.

- normal binocular response with no manifest deviation (NRC with no heterotropia)
- Harmonious ARC with manifest squint.

c) The patient sees two red dots, suppression of left eye.

d) The patient sees three green dots, suppression of right eye.

e) The patient sees five dots.

- uncrossed diplopia with esotropia, red dots appear to the right
- crossed diplopia with exotropia, red dots appear to the left of the green dots.

General principles of ophthalmic examination.

Physical examination and evaluation of the ocular system are greatly facilitated by a detailed history and a number of techniques that are performed in the office using equipment readily available through any optical or medical supply house. However, a specialist in a hospital setting must perform some of the more complicated techniques.

These techniques are discussed with a view to (a) their indications, (b) how they are performed, so that the referring examiner can explain to a patient what might be expected, and (c) the necessary information to aid the examiner in management of the patient.

Order of examination.

Examination of the eye and its surrounding tissues with and without special aids may give valuable information for the diagnosis and treatment of ocular disease. After acquiring the ophthalmic history, a systematic routine should be adopted for the examination, with particular attention paid to the patient's chief complaint. Additional tests may be required after the initial exam.

The typical order for nonemergency examination is as follows:

History. Chief complaint; present and past ocular problems; family history of eye problems; present and past general illnesses; previous surgeries; ocular and general medications; allergies; social history. Depending on the patient's particular problem, the history may be brief or extensive.

1. Name and address. Name and address are primarily required for patient's identification. It also proves useful for demographic research.
2. Age and sex. In addition to the utility in patient's identification, knowledge of the age and sex of the patient is also useful for noting down and ruling out the particular diseases pertaining to different age groups and a particular sex.
3. Occupation. An information about patient's occupation is helpful since ophthalmic manifestations due to occupational hazards are well known, e.g.: ocular injuries and trauma due to foreign bodies have typical pattern in factory workers, lathe workers, farmers and sport persons. Computer vision syndrome is emerging as a significant ocular health problem in computer professionals. Heat cataract is known in glass factory workers. In addition, information about the patient's occupation is useful in providing ocular health education and patient's visual rehabilitation.

Chief presenting complaints of the patients should always be recorded in a chronological order with their duration.

The common presenting ocular complaints are: defective vision, watering and/or discharge from the eyes, redness, asthenopic symptoms, photophobia, burning/itching/foreign body sensation, pain (eyeache and/or headache), deviation of the eye, diplopia, and black spots in front of eyes, coloured halos, and distorted vision.

History of present illness. The patients should be encouraged to narrate their complaints in detail and the examiner should be a patient listener. While history taking, the examiner should try to make a note of the following points about each complaint: mode of onset with duration, severity, progression, accompaniment of each symptom.

History of past illness. A probe into history of past illness should be made to know: history of similar ocular complaint in the past. It's especially important in recurrent conditions such as herpes simplex keratitis, uveitis and recurrent corneal erosions. History of similar complaints in other eye is important in bilateral conditions such as uveitis, senile cataract and retinal detachment. History of trauma to eye in the past may explain occurrence of lesions such as delayed rosette cataract and retinal detachment. It is important to know about history of any ocular surgery in the past. History of any systemic disease in the past such as tuberculosis, syphilis, leprosy may sometimes explain the occurrence of present disease. History of drug intake is also important.

Family history. Efforts should be made to establish familial predisposition of inheritable ocular disorders like congenital cataract, ptosis, strabismus, corneal dystrophies, glaucoma and refractive error.

General physical and systemic examination

General physical and systemic examination should be carried out in each case. Sometimes it may help in establishing the aetiological diagnosis.

Ocular examination

- External ocular examination.
- Testing of visual acuity.
- Fundus examination.

External examination.

A stepwise approach that includes inspection and palpation helps ensure that no details are overlooked. This process occurs automatically with increased experience.

- Inspection. The inspection should take place in a well lighted room. The patient's actions and appearance should be observed for clues as to the overall health of the patient, including signs for mental, neurological, medical, and dermatological diseases. Extremities, for example, can give clues to systemic diseases, such as rheumatoid arthritis, gout, or tuberous sclerosis. The head and face should be inspected for any masses or lesions, and these should be measured and drawn if present. The face is assessed for symmetry, signs of prior trauma, and motility of facial muscles. If a neurosensory deficit is suspected, the facial nerve function is assessed by asking the patient to close eyes forcefully, to smile and show teeth, and to lift the forehead, while muscle function is also assessed. The facial nerve sensation is then tested by comparing corresponding areas of both sides of the face with fingertips or cotton wisp, testing all three trigeminal dermatomes. The facial skin is evaluated for color, moisture, tone, texture, and vascular changes. The mouth and nose are then examined with a penlight for changes. The orbits can be evaluated for their anatomic relationship. In addition, if abnormalities are suspected, the intercanthal distance and interpupillary distance are measured with a ruler. The average pupillary distance is 61 mm. Any apparent signs of proptosis (exophthalmos) or enophthalmos should be noted and measured with an exophthalmometer, as detailed below. Further, the relative position and symmetry of the eyebrows are evaluated. Old photographs are an invaluable tool when abnormalities are detected to determine longstanding asymmetry and lesions. It is also important that the examiner take pictures when new findings or changes are noted.

- Palpation. Tactile, temperature, and proprioceptive senses are important when feeling for abnormalities. However, the examiner should be gentle and inform the patient about the process. In general, the thumb and index fingers are used to open the eyelids. The middle fingers are used to examine the preauricular lymph nodes. Masses are recorded for shape, size, tenderness, composition, and mobility.

Bony changes of the head and face are noted. Patients with sinusitis might complain of tenderness over the maxillary and frontal sinuses that can be elicited on palpation. In elderly patients, the temporal artery is palpated to reveal tenderness and tortuosity when giant cell arteritis is suspected. Neck vessels are palpated to evaluate the carotid artery

pulse and jugular vein hum. Lymph nodes are than palpated to evaluate signs of enlargement or tenderness. Preauricular, submandibular, superficial cervical, jugular, post-sternocleidomastoid, and supra-clavicular lymph nodes should be palpated.

When trauma is suspected, the orbital margins are palpated for signs of orbital fracture that include a step-off. The examiner should start laterally and proceed in a clockwise fashion, palpating along the orbital rim. It is, however, important to be certain that no globe rupture is present before doing so.

To evaluate eyelid masses, the closed eyelid is palpated gently by sliding the index fingers over the eyelid skin. Even when a mass cannot be seen, it can be felt.

In patients with epiphora, the evaluation of the lacrimal sac involves compression of the sac with the index finger or a cotton-tipped applicator to assess any refluxed material from the puncta. Mucus or mucopurulent material can be expressed and confirm an obstructed nasolacrimal duct. The color of the refluxed material should be noted. It should be noted that pressure on the globe might elicit the oculocardiac reflex with bradycardia.

- Extraocular motility

Normally, the two eyeballs are symmetrically placed in the orbits in such a way that a line joining the central points of superior and inferior orbital margins just touches the cornea. Normally the visual axes of the two eyes are simultaneously directed at the same object which is maintained in all the directions of gaze.

With the patient's head immobilized, the examiner asks the patient to look in each of the nine diagnostic positions of gaze: 1, straight ahead; 2, right; 3, upper right; 4, up; 5, upper left; 6, left; 7, lower left; 8, down; and 9, lower right. This allows the examiner to diagnose strabismus, paralysis of ocular muscles, and gaze paresis. Evaluating the six cardinal directions of gaze (right, left, upper right, lower right, upper left, lower left) is sufficient when examining paralysis of one of the six extraocular muscles. The motion impairment of the eye resulting from paralysis of an ocular muscle will be most evident in these positions. Only one of the rectus muscles is involved in each of the left and right positions of gaze (lateral or medial rectus muscle). All other directions of gaze involve several muscles.

Binocular alignment is evaluated with a cover test. The examiner holds a point light source beneath his or her own eyes and observes the light reflections in the patient's corneas in the near field (40cm). The reflections are normally in the center of each pupil. If the corneal reflection is not in the center of the pupil in one eye, then a tropia is present in that eye. Then the examiner covers one eye with a hand or an occluder and tests whether the uncovered eye makes a compensatory movement. Compensatory movement of the eye indicates the presence of tropia. However, there will also be a lack of compensatory movement if the eye is blind. The cover test is then repeated with the other eye. If tropia is present in a newborn with extremely poor vision, the baby will not tolerate the good eye being covered.

-The near point of conversion (NPC) is the point closest to the patient at which both eyes converge on an object as it is brought toward the eyes. This point is normally between 6 cm and 10 cm in front of the eye. The moment one eye begins to deviate outward or the image doubles, the limit of conversion has been reached. A NPC greater than 10 cm is considered abnormal and may result in excessive tiring of the eyes on close work such as reading or sewing.

-Pupillary examination. The pupil size, shape, location, and reaction to light, can be altered by numerous pathologic disorders. The examiner begins with observation of the pupil. The pupillary reflexes are tested with the light-reflex test, the swinging flashlight test, and the near-reflex test.

-Pupillary observation and light-reflex test. The patient should be asked to fixate a distant target to minimize accommodation and miosis. In a semidark room, a flashlight is held from below the nose to illuminate the pupil. The pupil size should be measured with a ruler or near vision chart. A difference in pupil size between eyes (anisocoria), as well as the shape and location, should be noted. Further, the direct pupillary response to the light in terms of briskness should be graded separately for each eye from 0 for no response to 4+ for brisk response. In addition, the consensual response should be evaluated by observing the pupillary response of the nonilluminated eye.

-Swinging flashlight test. This test determines the presence or absence of a relative afferent pupillary defect (RAPD). Similar to the light-reflex test, the handheld flashlight is used to illuminate the pupils. The constriction of the pupils is observed. The light is then moved immediately over the patient's nose to the other eye, and the pupillary response is noted. In a normal patient, the pupil will slightly constrict or stay unchanged. However, if the pupil dilates, a RAPD is present, indicating optic nerve or severe retinal damage. The light is then moved back swiftly to the other eye and the response noted. This process should be performed several times, spending equal amount of time illuminating each eye. The presence or absence of a RAPD and the location should be noted.

- Near-reflex test. This test is based on the fact that looking at a near target is associated with convergence, accommodation, and miosis (near synkinesis). These three processes occur simultaneously. The patient is initially instructed to look at a distant target. A target or a finger is than held in the patient's line of vision, and the patient is asked to shift fixation to the near target. The pupillary response is observed. Normally both pupils constrict simultaneously. The test may need to be repeated several times to obtain best results. Under normal conditions, if the pupil reacts to light, it will react to accommodation, as well.

Visual acuity should be tested in all cases, as it may be affected in numerous ocular disorders. In real sense acuity of vision is a retinal function (to be more precise of the macular area) concerned with the appreciation of form sense.

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