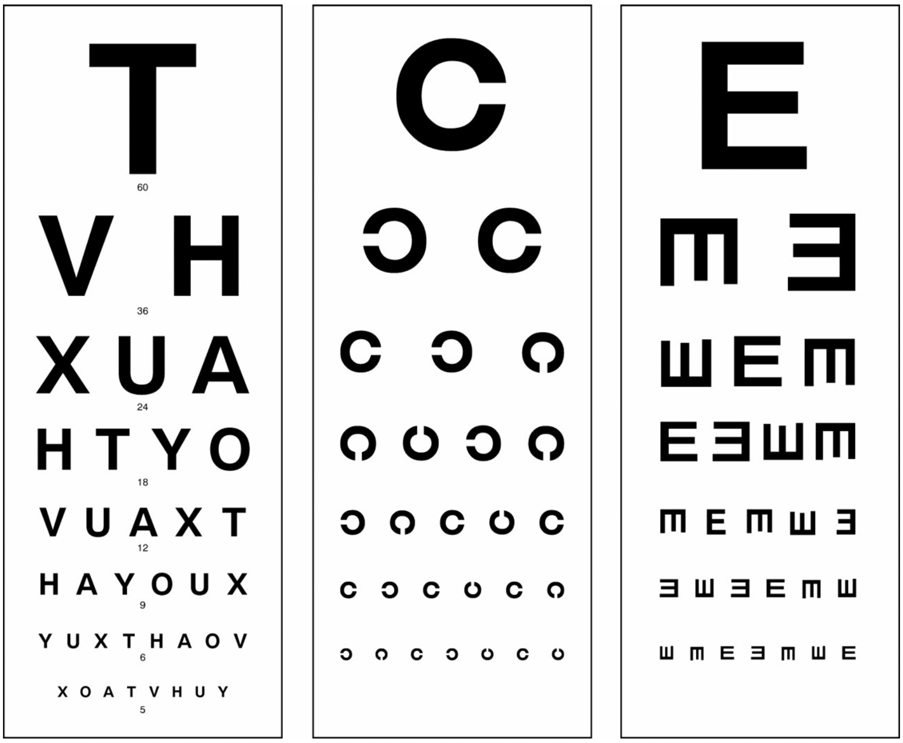
VIII. THE ORGANS OF SENSE

1. Visual acuity testing

To measure visual acuity an eye chart is used. Charts usually display several rows of test symbols (e.g. black Snellen letters and numbers or “Landolt C”s (incomplete rings) against a white background), each row in a different size. The person is asked to identify the numbers or letters on the chart, usually starting with large rows and continuing to smaller rows until the symbols cannot be reliably identified anymore. Each symbol row is associated with a charachteristic distance (it is represented on the chart beside the rows) from where the figures can be seen in a visual angle of 5 minutes of arc (5'), while details of the figures in a visual angle of 1'. The visual angle of the uppermost figure is 1' from 50 meters, while the figures in the penultimate row from 5 meters (figures of the last row are used for hyperacuity testing). Symbols on the chart are placed in a square distributed into 25 small squares. Each of the small squares gives a visual angle of 1', while the large square gives a visual angle of 5'.



a **b** **c**

Eye charts (a: Snellen, b: Landolt C and c: illiterate E)

The chart should be well illuminated during the test. The person to be tested is sitting 5 meters from the chart which is suspended at eye level. The patient covers an eye with the ipsilateral hand or holds an eye card over the eye. The patient is requested to read the letters, numbers or figures starting from the top. The examiner looks for the smallest symbol readily recognized. The degree of visual acuity determined is expressed as a fraction number:

$$V=d/D$$

d = is the distance (m) of viewing

D = is the distance from where the symbols are recognized at 5' visual angle, while its details at 1' visual angle.

Normal value: 1 (V = 5/5)

If the person can see the characters of the size that he/she should be able to see at 5 m, the subject is said to have 5/5 visus, that is normal. If the patient can only see characters that should be seen from 50 m, than the visus is 5/50. The characters are viewed in a visual angle of 5 minutes of arc (5') from the distance indicated, while details of the figures in visual angle of 1'. If the patient recognizes symbols giving 5' visual angle from 15 m (which is recognized at normal vision from 15 m), visual acuity will be V = 5/15.

If the patient tested cannot see the largest symbols, the chart should be placed closer. If the patient can view the topmost symbol from 2 m, then the visual acuity will be 2/50.

If visual test is unsuccessful, counting of fingers is made from a distance of 5 m. In these case the distance is given instead of visus from where the patient can count fingers shown at dark background (e.g. finger counting from 2 m). If the patient is unable to perform this task, light-dark perception is tested.

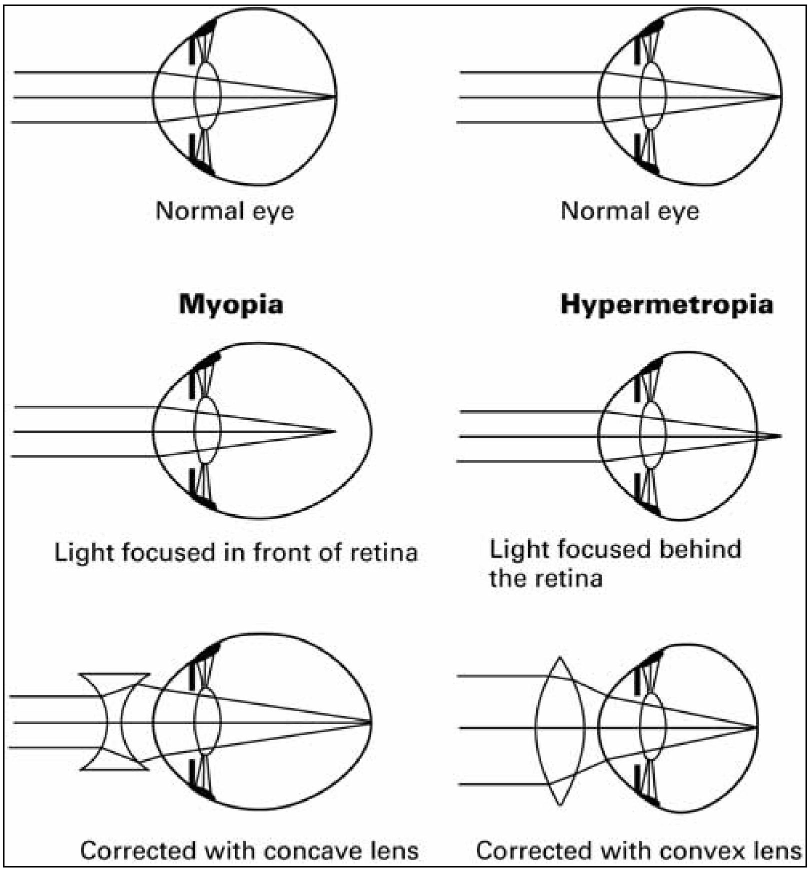
2. Refractive error correction (principle)

The patient is tested with an eye chart; if deviations are found, different lenses are placed before the eyes to find the lens correcting the error. The lens set contains biconvex, biconcave and cylindrical lenses of different refractive power which can be placed in a frame. Refractive error of one eye is corrected at a time, the other is covered with the black metal slip of the spectacle.

a) Normal, relaxed, not accommodating eyes refract parallel rays that way they project a sharp image on the fovea centralis of the retina: emmetropic eye.

b) Myopia (short-sightedness): the longitudinal axis of eye is longer than normal (24 mm), or its refractive power is too strong for the length of the bulbus, and the sharp image is formed infront of the retina. Myopia is corrected by concave (negative) lenses placed before the eye causing light rays to diverge and form sharp image at the retina.

c) Hypermetropia (far-sightedness): the longitudinal axis of the eye is shorter than the normal, or the refractive power is too weak related to the length of bulbus: parallel rays arriving at the eyes (would) form thze sharp image behind the retina. Placing convex (positive) lenses before the non-accommodating eyes cause light rays to converge and form sharp image at the retina.



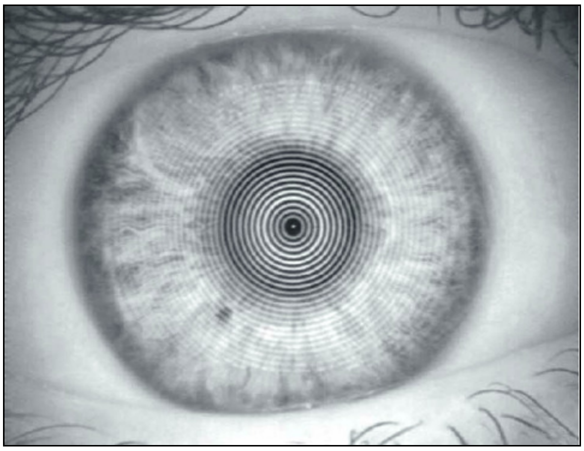
Refractive errors and their corrections

3. Detection of astigmatism

If the curvature of the cornea is different along the different meridians, the image will be distorted. This condition is called astigmatism. Normally the cornea has a 0.5 D (diopters) stronger refractive power in the vertical plane: this is called physiological astigmatism. Regular astigmatism: the curvature is regular within the same meridian and the meridians of the weakest and strongest refractive power of the eye meet at a right angle. Their correction is possible with cylindrical lenses having a convex or concave surface.
The cylinder acts like a plan-parallel sheet of glass plane along its axis, and it does not refract light, but its refraction is maximum perpendicularly to the axis and the transition between the two stages is not linear.

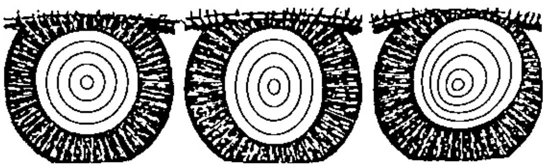
Detection of astigmatism can be performed by:

<u>a) Placido's disk:</u>
The disk having a diameter of 25 cm is equipped with a handle. On the surface there are concentric circles with a round hole in the middle. The person to be tested is standing with his/her back to the light, the examiner looks through the hole and checks the image of the concentric circles on the subject's cornea.

Placido's disk

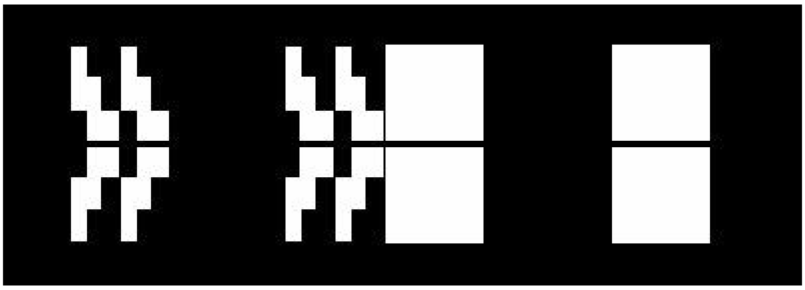
If the curvature of the cornea does not differ too much in the different meridians, then the reflected concentric circles are similar to those on the keratoscope. In the case of astigmatism, however, concentric circles reflected on the cornea are distorted and shifted (like altitude lines on a map).



Astigmatism

b) Javal-Schiötz ophthalmometer:

Refractive power and radius of curvature of the cornea can be determined with this instrument in any meridian. A chin stand is adjusted so that the eyes are at the correct level and one eye is covered. The test has to be performed in a dark room. The ophthalmometer projects two light rings that have to be focused onto the patient's cornea and the device has to be shifted until the rings fuse on the cornea. Afterwards this focusing light is covered. Through a telescope placed perpendicularly to the central point of cornea two images (a square-like pattern and a staircase-like figure) are projected on the cornea. Each figure can be seen doubled. Sharpen the image and by turning the ring on the telescope move the two medial figures that way that they touch each other. At this position the curvature radius and the refractory power in this meridian can be read in the smaller telescope on a scale of the device.
Normal Value = 42.75 - 43.40 D or 7.8 mm.
Now turn the telescope 90 degrees and check the pattern again. If the position related to each other did not change the refractory power and curvature radius in this meridian are the same as they were in the previous one. If the figures are shifted, try to set back the original situation (as it was 90 degrees before), and read the values on the smaller telescope. The difference between the values obtained in the original and in the new position will give the value of astigmatism. Astigmatism is considered "physiological " if the value of it does not exceed 0.5 D. 1 step overlapping = 1 D refraction difference.



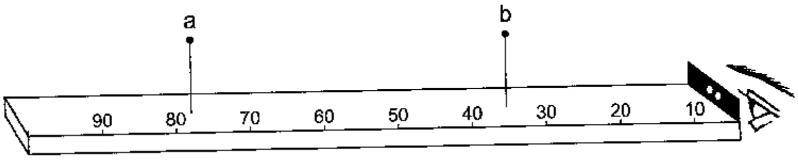
Figures of the Javal-Schiötz ophthalmometer

4. The accommodation test

Accommodation is the process by which the eye changes its refractive power to maintain a clear image on an object as its distance varies.

a) Scheiner's net test:
Printed text is read through the plain-net. The net is not seen while reading the text. If the net is fixed with the eyes, the text cannot be read, since it is blurred. However, we can choose which object to fixate on i.e. we can change the refractive power of our eyes.

b) Scheiner's test:
Two pins are fixed on a rod at about half a meter distance. At one end of the rod there is a metal piece with two round holes; the distance of the holes should not be larger than the diameter of the pupil. When looking through the holes and fixating the closer pin (b), the pin being farther (a) will be seen double and vice versa.



Scheiner's test

Human eyes are adjusted (accommodated) to view objects in one plane, objects inside and outside of the fixed plane do not fall on corresponding retina points and seem to be double.

5. Mariotte blind-spot test

There are spots within the normal visual space which are not perceived since light rays coming from them reach the "head of the optic nerve" the papilla where photoreceptors are not present.

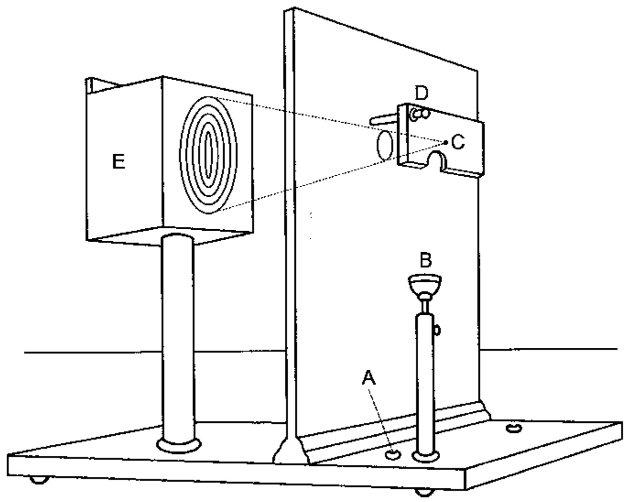
An image similar to the one represented below is held before the eyes at about a distance of 20 to 25 centimeters. The left eye is closed and the cross in the figure is fixated. Moving the picture slowly back and forth the distance is found from where the circle in the picture cannot be seen.
The image of the cross (+) falls at the fovea centralis, while that of the circle on the blind spot which does not contain rods or cones, thus we cannot see it. However, it does not cause any problem in everyday life: we do not perceive a "hole" in our visual world, the visual system completes the image.

Mariotte blind spot experiment

6. Testing the light-response of the pupil

Inducing the direct light response: one of the eyes is covered, while the other one is illuminated with a medium or weak light; the pupil will constrict. Pupil will dilate to the original size if illumination is stopped.
Consensual reaction: Light shown in one eye will cause a constriction of the contralateral pupil.

The light reaction of the pupils can be tested even in our own eyes with the help of a pupilloscope. We place our chin on the chin-stand (B), through the hole (C) we can view the concentric circles (E) on the board and try to fixate on the middle.
Pushing the test button we switch on the light illuminating our left eye. The left pupil will constrict and due to the consensual light reaction so will the right pupil. Because the light beams from the periphery are closed out we shall see 2-3 circles less when the light is on. If the light is turned off both pupils will extend, and with our right eye we shall see all of the concentric circles again.



Pupilloscope

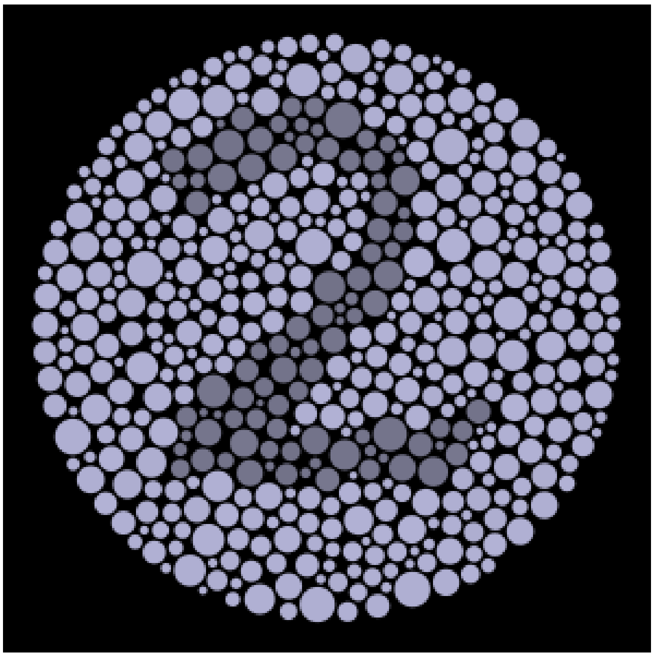
7. Testing color blindness

a) Holmgren's test:

A box of thread having different color and shade is used in this test. A sample is taken from the box and the patient is asked to choose the same color. In case of color blindness the person tested cannot perform the test quickly. The type of color blindness can also be estimated (e.g. red-green mixing people often choose green threads when they are told to select red ones). This is not a very reliable test, however, it is very simple, does not need instrumentation and can be performed on poorly educated subjects or on persons who can not cooperate well (e.g. children).

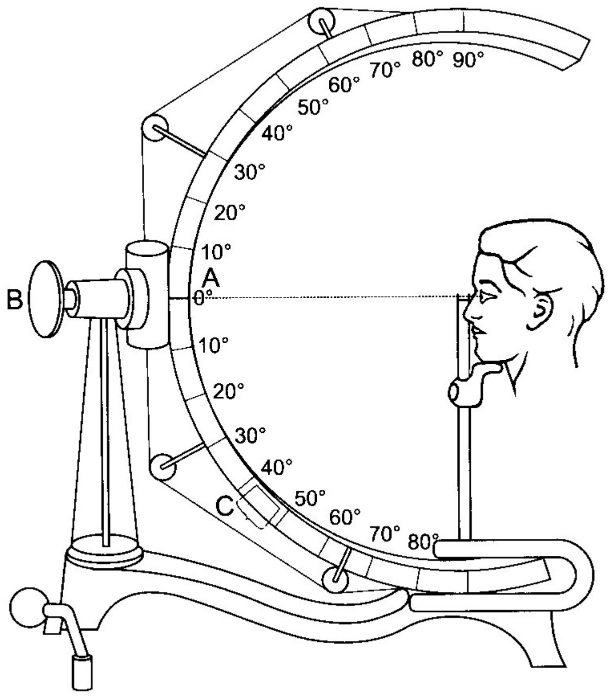
b) Pseudoisochromatic (Ishihara) plates:

The plates are viewed in diffuse light at a distance of 0.5 m. There are some marks, lines, numbers or letters different from the background color of the plate. The color of the mark to be recognized is readily distinguished by persons of normal color vision, whereas persons with color blindness will not find the mark. The colors are not homogeneous, they consist of spots, disks, or wavy lines, thereby the effect of contrast can be ruled out.



Ishihara plate

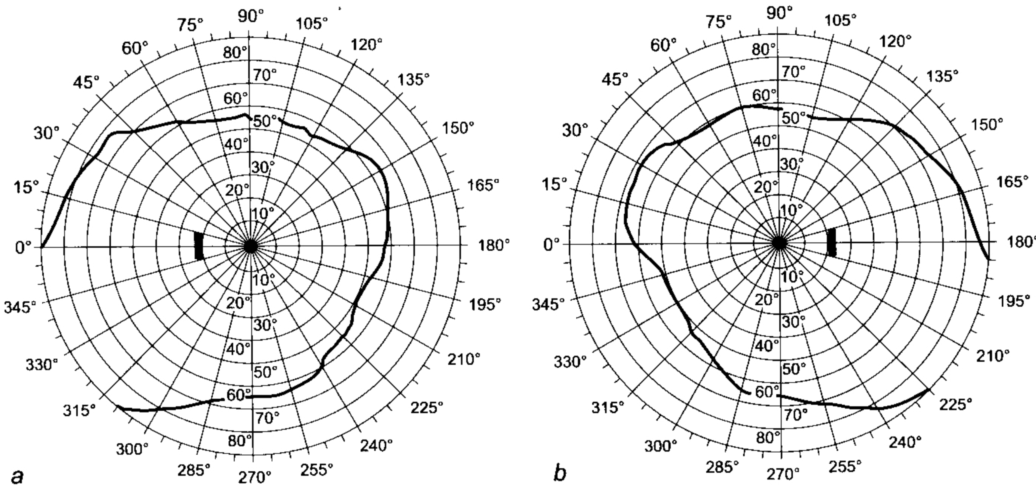
8. Testing the size of the visual field (perimetry)



Perimeter

The visual field is the a area of space viewed at with motionless eyes. The purpose of the test is to define the space viewed by the patient, the recognition of a possible scotoma, its localization and determination of its extent.

The most simple method of testing visual field is the “confronting test” of the visual field. The patient is seated opposite the screen at a distance of 1 meter. His right eye is covered and asked to look into our right eye with his/her left eye, while we cover our left eye. With the index finger we move from the periphery to the center from several directions and the patient gives a signal when he sees our finger. If both the patient and the examiner fixate each other's pupils and their visual fields are intact they will perceive the movement of the hand at the same time. The same examination should be repeated with the other eye.



Visual field of the left (a) and the right (b) eye

This method is not sophisticated, it can detect a large scotoma only. For a more accurate testing a perimeter is required. It is an illuminated half-sphere or an arch having a radius of 0.33 m. The patient's eye is positioned in the geometrical center of the sphere/arch, he/she looks on the inner surface. The extent of visual field can be tested with a small blinking light along each meridian or a moving paper sign with this test.

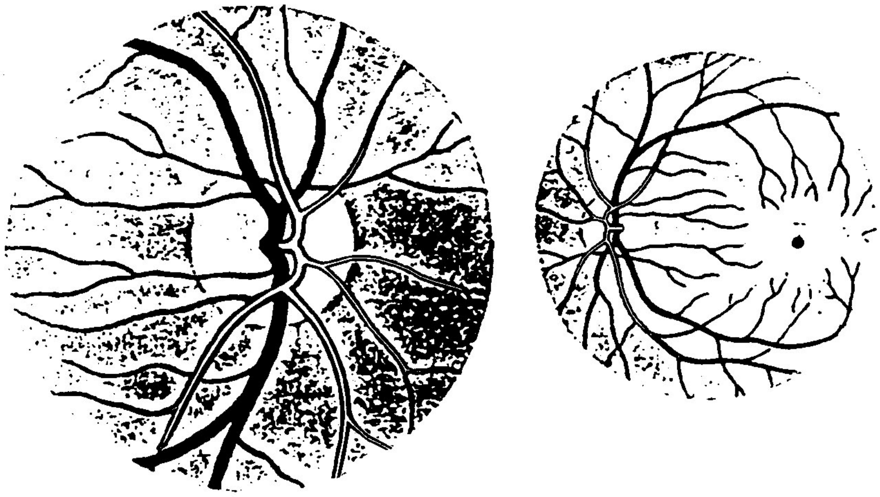
The chin of the patient is placed on the stand in a position that the eye tested is at the level of the central point of the sphere and can be fixed with the eye tested. The other eye of the patient is covered. A white paper sheet (or paper of the desired color in case of color perimetry) is fixed in the groves of the arch. It is first located at the periphery then slowly proceeded towards the center. The patient is asked to give a signal when detecting the mark. The value obtained is recorded on the patient's perimeter diagram. Next the marker is moved slowly in the same meridian between the two extreme points to test any scotomas.

The test is repeated rotating the arch of the perimeter into different meridians of each eye. By joining the recorded points the outermost borders of the visual field can be recorded. Compare the results obtained with the physiological visual field (indicated in the diagram with dotted line). Deviations from the normal values can be given indicating the meridians where they were detected.

Visual fields of both eyes are 100-120 degrees vertically, 180 degrees horizontally when the eyes are stationary; with moving eyes it is 200 degrees vertically and 260 degrees horizontally. The two visual fields partially overlap.

The determination of the visual field for colors is performed in a similar way by applying the desired colored mark. The size of the visual field is different for different colors; it is the largest for white followed by blue and red and the smallest one is for green.

9. Ophthalmoscopy



The fundus of the eye as seen with an ophthalmoscope

The test is based on the fact that the light that is projected through the pupil is not fully absorbed but a part of it is reflected back; light rays will exit from the eye at the same angle as they entered. Under normal circumstances the pupil seems to be black because our head prevents the entry of those very light rays that would be reflected back towards our eyes. If we use light of proper intensity and illuminate the eye of a person the light that is reflected will be sufficient for the examiner to view the back of the eye, the fundus. When performing ophthalmoscopy the examiner shines a parallel light ray into the eye. The eyes of the examiner and the examined have to be in the same optic line (axis) so that light that would be reflected from the fundus can be seen. For the test we use an ophthalmoscope which has a built in light source and has a series of lenses which can be used for making refractory corrections. The lenses help to create parallel light which can be used to look into the eye and visualize the fundus.

The examiner looks through a little hole above the mirror which reflects parallel light into the eye tested. Various lenses can be selected by turning a dial. Options include: 0, +10, -10, - 20, D or in the upper part of the equipment you can insert other lenses with lower D values; a range of +20 to -30 D can be obtained. In addition a green filter can also be used; this makes shades of red darker, increases the contrast and helps to differentiate between the items of the fundus.

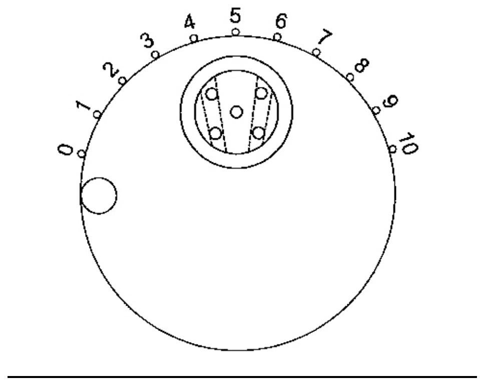
The test is performed in a moderately dark room (it is easier with a dilated pupil). The examiner and the examined are sitting opposite to each other. The examination is always done with the right eye of the examiner examining the right eye of the examined, and like wise for the left.

If both the examiner & examined are emmetropic and neither of them are accommodating then the light rays coming from the examined eye will focus on the fovea centralis of the examiners retina, and the fundus will be seen sharply. If one of the two eyes (or both) is not emmetropic, the fundus cannot be seen sharply. In this case both eyes have to be made emmetropic. To overcome this problem adjustments are made on the lens dial of the ophthalmoscope, first with a convex lens, then (if they do not help) with a concave lens, until the fundus can be seen sharply.

To exclude accommodation, both persons are fixing at a (imaginary) distant point. This way light beams coming from the fundus are made parallel by the lens, these beams are collected together again by the eye of the examiner on his/her retina.
A detailed image of the fundus can be seen if neither the eyes of examiner nor that of the person tested are accommodating, and none of them have any refractory errors. The retina will be seen as shining red. The bright red, thin lines are vessels in the fundus. If one of these vessels is followed proceeding in a central direction we can reach the papilla of the optic nerve (a light pink disk). Other arteries and veins can also be seen. Arteries are thinner and of lighter color, while veins are thicker and a bit darker. Moving temporal from the papilla the macula lutea can be seen as a darker gray-red region.

10. Testing dark-adaptation with Birch-Hirschfeld's adaptometer

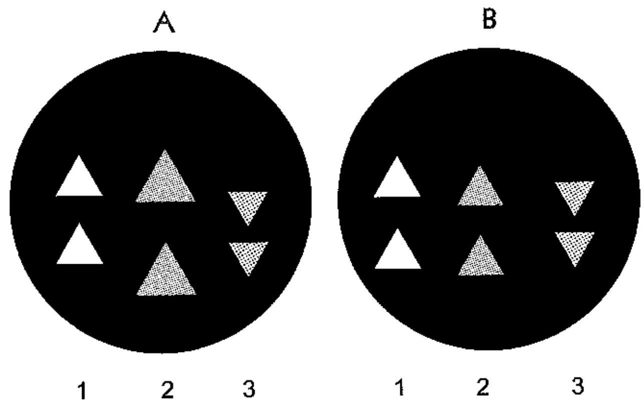
The instrument is made of two revolving disks, with a series of glasses with different light transmission ratios in the front disk. Light transmission of the consecutive glasses is 50 %. White, red and blue glasses are in the second disk, which serve for testing the adaptation to white, red and blue colors. Five light spots can be seen on the surface of the instrument. There is one in the middle, and the spots on the left are twice as bright while those on the right are twice as dark.
The testing procedure is as follows. The examiner and the person to be tested enter together the dark room and the examiner sits about 30 cm from the adaptometer. The frontal disk of the instrument is turned completely to left. First the light sensitivity of the examiner is tested. Turn the disk to the right until the light spot in the middle can be still perceived and the two lighter spots are also well visible. The patient is then asked about the number of spots he can see, and if he can see the spot in the middle, the initial light sensitivity of the two persons (examiner and the patient) is the same. If the patient cannot see anything, the disk is turned further to the right until the patient can perceive the spot in the middle. If, however, the patient can see all the five spots, his initial light sensitivity is greater than the examiner's.



Birch-Hirschfeld's adaptometer

11. Purkinje-Sanson mirror-images

The lens of a flashlight is covered with black paper on which two triangles are cut out. In a dark room the eye of the patient is illuminated with the flashlight from the side direction. Size and distance of the so called Purkinje-Sanson's images can be observed in the refraction surface of the eye during far and close accommodation.



Purkinje-Sanson's images

a) If the eye tested looks far in the distance (diagram A) we see three images reflected
1 - from the cornea
2. - from the frontal surface of the lens
3. – from the posterior surface of the lens

Of those seen 1 is the sharpest, this is coming from the fovea. 2 & 3 are coming from the anterior surface of the lens and of the posterior surface, respectively. These images are hazy because light is absorbed in the aqueous humor and in the lens. Images 1 and 2 (images of convex surfaces) are reduced and are in normal position. The 3rd image (reflected from the posterior -concave- surface of the lens) is reduced and up side down.

b) If the eye tested looks close (diagram B) the 2nd image (coming from the frontal surface of the lens) will be smaller and gets closer to the center of pupil. During accommodation the curvature changes on both lens surfaces but the frontal surface change dominates.

12. Investigation of the critical fusion frequency

A feature of the retina is that a light sensation can lasts longer than the actual light stimulus; even when the stimulus has ceased, light is still seen in the form of positive after-images. Short lasting stimuli of high frequency tend to fuse.
For the test we use an instrument emitting a series of light pulses with different frequencies. Set a high frequency value which is well above the critical fusion frequency. Next the frequency is gradually reduced until the patient does not see a continuous light but rather a vibrating one. The frequency value read at this point is the critical fusion frequency, generally seen to be around 40-50/sec (Hz). This value may depend also on light intensity, with increasing light it can be as high as 60-70 Hz.

13. Investigation of nystagmus

Nystagmus (a rapid, involuntary, conjugated, cyclic and rhythmic movement of the eyeball) comes about during the excitation of the receptors in the ampulla upon both spontaneous and artificial stimuli. It can also be triggered by the stimulation of vestibular apparatus or the movement of visual field. It consists of a rapid and a slow element. The latter is of labyrinth origin, while the former is a central, correctional movement. The direction of the nystagmus is named traditionally after the direction of the fast component.

The phenomenon of optokinetic nystagmus can be observed if e.g. someone is looking out of the window of a train. Telegraph poles, or trees pass by, the eyes follow them until they disappear at the window's edge (slow component), then the eyeballs return back to the starting position (quick, "saccadic" eye movements) to catch a new (tree) object to follow and so on.
The process of investigation is as follows: the rotating drum of the kimograph is covered with paper having of vertical black and white stripes and looked at. An observer from behind the kimograph will be able to observe the optokinetic nystagmus.
Postrotatory nystagmus is triggered by rotation and can also be tested. The patient is seated into the revolving chair (Bárány's chair). To rule out visual fixation the patient is provided with glasses of 20D convex lenses (Frenzel's glasses), or the eyes are closed. The chair is than turned. If the chair is suddenly stopped, the endolymph in the horizontal semicircular canal will move due to its inertia and the cupula will bend opposite to the direction of rotation, thus the direction of the nystagmus will be the opposite of the direction of the rotation (postrotatory nystagmus).

14. Laryngoscopy

The patient is seated with a strong light-source above his/her shoulder. The examiner puts on a forehead mirror (a concave mirror with a hole in the middle). The examiner should be able to look through the hole and direct the reflected light to the desired location. The examined person opens his/her mouth while the tongue can be pressed down with a spatula. A small mirror is then introduced along the soft palate behind the uvula to reflect light down on the glottis. The mirror is pre-warmed to avoid developing condense water then checked on the hand to be sure it is not too hot. Touching the root of the tongue or the pharyngeal arches should be avoided since it might cause regurgitation. The image in the mirror can reveal the epiglottis and the plica aryepiglottica on both sides, the frontal part of the epiglottis can be seen in the top of the mirror, while the back part is seen at the bottom. The two white vocal cords can be seen in the middle surrounding a triangular opening. The space between the vocal cords dilates upon inhalation, while it constricts or completely closes during phonation.

15. Otoscopy

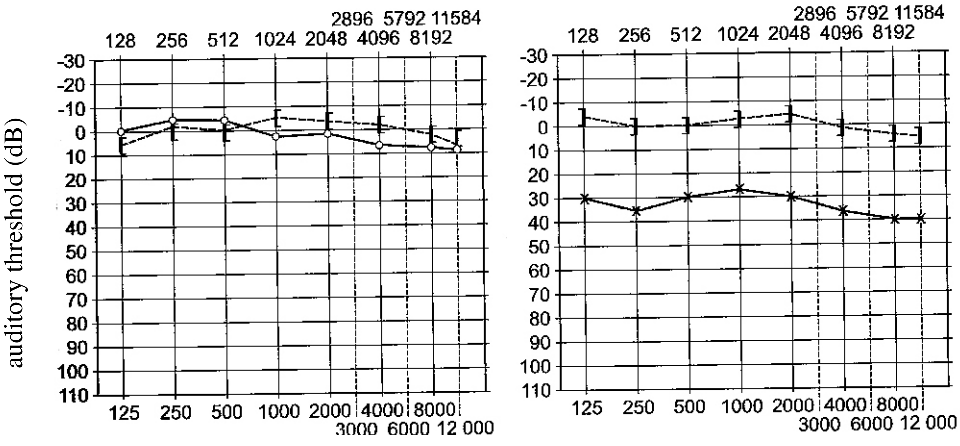
A light source is placed close to the head of the patient; and the examiner puts on a forehead mirror. For the examination, the curvatures of the external acoustic duct (meatus) have to be made straight by gently pulling the external ear (auricle). In adults the pulling direction is backwards and upwards while in children backwards and downwards. Next a metal ear-speculum is introduced into the meatus (one should progress carefully, the inner 1/3 of the meatus is running in the bone and pressing on the periosteum might be painful.
First the eardrum (tympanic membrane) is observed; it is a light grey, mother-of-pearl colored, oval shaped membrane around 8-10 mm in diameter. It's retracted part indicates the adhesion place of the malleal process.

16. Investigation of Acoustic Acuity

a) The examiner is standing at about 5 meters distance from the patient. The patient covers the ear on the opposite side, while short words of 2 or 3 syllables are whispered, which should be recited by the patient. If the patient cannot recognize them from 5 meters, then the test is continued by approaching the patient one meter each time. Finally the distance from which recognition is complete is given. E.g. in impaired hearing of the conductive type deeper sounds, such as "a" and "o" are not recognized.

b) Drop-test
The instrument is a vertical rod with 1 mm calibration, with a sliding holder and a felt lined box underneath. A metal ball is dropped into the box from gradually decreasing height. The patient is standing at a meter away with his back to it and indicates the recognition of the dropping of the ball. Acoustic acuity is expressed by the lowest height when the patient still hears the sound of the ball dropped.

c) With audiometer
During the so-called threshold audiometry the acoustic threshold of both ears is determined at different sound frequencies. The instrument, an audiometer, is an electric sound-generator, which generates sounds of different frequencies (60-20000 Hz). The intensity (auditory threshold) of the lowest detectable sound is defined and plotted as the function of the frequency. Values obtained in dB at the given frequency will show the deviation from the normal threshold. An important precondition of the test is a quiet (sound-proof) room. During testing the aerial conduction the two ears have to be isolated acoustically from each other. This is done by a headphone with built-in loud-speakers and noise-generators. The patient is sitting with the headphone on his head and he should not see the switchboard of the instrument.
The sound of required pitch is adjusted (frequency), a masking noise of 50 dB is given in the other ear, and starting from 10 dB the sound intensity is gradually increased. The patient indicates when the sound is detected.
(The first measurement usually has to be repeated until the patient gets the required experience in cooperating in the test).
Threshold values of all the frequencies available are defined and the values obtained in dB are plotted as the function of frequency. Then the other ear is tested, the results are plotted on separate diagrams.
In case of normal aerial conduction a curve closely fitting the 0 line should be obtained. A 10-15 dB deviation is still acceptable. In case of any disturbances in aerial conduction the threshold of sounds with lower frequencies (<2000 Hz) is increased.
Investigation of bone conduction is carried out with a special vibrator placed on the mastoid process after properly adjusting the audiometer. No masking noise is applied and the test is performed as described above. If bone conduction is disturbed, the sensation of higher sounds (>2000 Hz) is decreased.



Audiogram

17. Tests with tuning fork

Under physiological conditions sounds between 16-2000 Hz reach the organ of Corti through aerial conduction. In this range there is a combined bone and aerial conduction but the threshold for bone conduction is about 50-60 dB higher, thereby it's role is not significant. Conduction of sounds with a frequency higher than 2000 Hz occurs mainly by bone conduction (the middle ear ossicles -as a mechanical device- cannot follow the high frequencies).

Differentiation between aerial and bone conduction is performed with a tuning fork, through which the perceptive or conductive character of a possible hearing loss can be determined. In the case of a conductive (otogen) hearing loss, the aerial conduction is impaired, and sound waves do not reach the receptor cells. Perceptive hearing loss is associated with the lesion of receptors, auditory pathways or that of the auditory cortex.

a) Weber's tests:

A vibrating tuning fork is held against the forehead. Under physiological conditions the sound is heard equally by both ears of the patient. In case of a conductive hearing loss the sound is heard louder on the impaired side (lateralization). In case of impaired aerial conduction, weaker sound reaches the internal ear which has become adapted to a lower noise level and its receptors become more sensitive than those of the healthy side (e.g. in otitis media-inflammation of the middle ear). In case of perceptive deafness the sound is better heard with the intact ear.

b) Rinné's test:

In this test aerial and bone conduction of the same ear is compared. The handle of a vibrating tuning fork is placed on the mastoid process of the patient (bone conduction) until it is no longer heard. Next the still vibrating tuning fork is held near the ear of the patient (aerial conduction). Under normal conditions aerial conduction is better than bone conduction, therefore the sound can be heard by the ears i.e. the test is Rinné positive. In case of conductive hearing loss, the aerial conduction is shortened and after ceasing of bone conducted sound the patient does not hear the sound of the forks. In perceptive impairments the test is positive.

c) Schwabach's test:

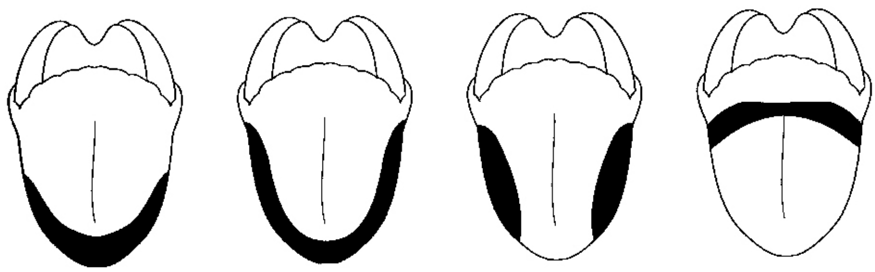
Bone conduction of the examiner with intact hearing and that of the patient is compared. The shank of a vibrating tuning fork is placed on the mastoid process of the patient until its tone is no longer heard, then transferred to the mastoid of the examiner (whose hearing should be normal). If the examiner does not hear the sound, the test should be repeated in the inverse sequence. In case of perceptive hearing loss the examiner hears the sound longer: the Schwabach test is shortened. In case of a conductive disturbance the patient will hear the sound longer: the Schwabach test is elongated.

18. Bárány's pointing test

During this test the coordination of motor activity is tested, usually together with other tests of cerebellar functions.
Our index finger is pointed forward. The patient is asked to look at it, lift his arms up and try to sink his/her fingers to our index finger's level with the eyes closed. In case of cerebellar lesion the arm on the ipsilateral side will deviate to the side.
Disturbance in coordination can be evoked experimentally, if the patient is turned around in a revolving chair for 1 minute or so and perform the test right after stopping.

19. Sense of taste

The test is performed for 4 basic tastes. The patient sticks out the tongue which is touched at different places with a glass rod that had been immersed in different solutions, diluted glucose, salt, acetic acid and quinine (the quinine solution is always the last). The patient rinses the mouth after each taste sample. On a prepared table the patient (with his tongue still out) points on the name of the different taste qualities. One should observe that sensation of different tastes cannot be evoked on the tongue on any locations. Different parts of the tongue react to different tastes, tip to sweet, sides to sour, root to bitter.

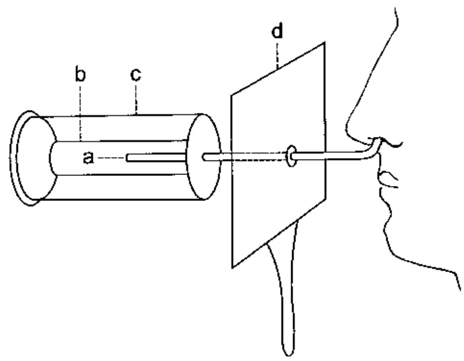


Localization of taste qualities

20. Testing the sense of smell with an olfactometer

During this test the individual sense of smell is measured. The instrument used is the olfactometer, which is a calibrated glass tube (a) the bent part of which is introduced into the nostril. The other end is placed into a porous clay cylinder (b) surrounded by a glass cylinder (c). There is a wooden plane for shading between the external end of the glass tube and the glass cylinder.

The clay cylinder is soaked with some odorous substance. If the cylinder is completely pulled over the glass tube the patient will not smell the odor because air is coming through the end of the glass tube. If, however, the glass tube is pulled out slightly the air mixing with the odorous substance will come through the cylinder. Position of the glass tube should be there where the patient still perceives the smell.



Olfactometer

21. Tests of somatic sensations

During this test corresponding symmetrical points on the body surface are compared; that is the injured part with the intact. Borderline between lesioned and healthy areas is determined with very light stimuli.
Anesthesia: lack of any sensation.
Hyperaesthesia: excessive sensitivity to stimuli.
Hypaesthesia: decreased sensitivity to stimuli.

<u>a) Pressure sense:</u>
The test is performed with an instrument having a blunt tip. The phenomenon of dermolexia can be observed i.e. the patient can normally recognize letters or numbers drawn on skin.

<u>b) Sense of touch (tactile sense):</u>
Skin surface to be tested is touched with a small cotton swab; the patient with eyes closed gives signal upon touching. A piece of hair (from a horse-tail, the so-called Frey's hair) can be used as well; the hair is pressed on the skin until it bends.

<u>c) Pain:</u>
Different points of the body surface are prickled with a blunt tipped needle, the patient has to give a sign when sensing the pain.

<u>d) Spatial resolution of tactile stimuli:</u>
Calipers are used for this test. The distance between the tips of the calipers is gradually decreased until the two tips cannot be sensed separatedly anymore. This threshold value ("minimum separabile") differs in different parts of the body (e.g. it is 2 mm on the fingertips, 70 mm on the back).