Name and Surrname number Study group

Protocol

Eye examinations

1. Astigmatism

Astigmatism can be objectively proven by observing the distortion of the image produced by the reflection on the front surface of the cornea (the first Purkyně image): a circle appears here like an ellipse. In a subjective way, astigmatism may be proven by observing figures composed of fine parallel lines with various orientations. Lines whose directions are perpendicular to the plane of atypically curved meridians are seen as evenly grey areas.

Equipment

Keratoscope of Placide, figures of Fuchs

Procedure

A **Fuchs figure** is used for subjective evidence of astigmatism. It is a rosette, the spokes of which are composed of fine transversal lines. The figure is to be observed from a distance of 3 meters while fixing the gaze on its center. Usually only some of the spokes are seen as cross-striated whereas other ones, mostly perpendicular to them, appear evenly grey or their striation is less marked. The method is very sensitive and can document even the physiological astigmatism.
If the physiological astigmatism is not distinct enough, one can make a simple experiment to get an idea of how an astigmatic eye might see: one applies a slight pressure on the ocular bulb from both sides with two fingers put on the upper lid whereby the cornea is slightly deformed. A very slight pressure is sufficient to produce a distinct astigmatism.

Placide's keratoscope is used to estimate astigmatism in an objective way. The method is much less sensitive and cannot prove physiological astigmatism. The keratoscope is a disc with a central peephole with a lens. Around the peephole there are white and black concentric circular stripes. Looking through the keratoscope peephole, the examiner approaches the subject's eye so near that the image of concentric circles fills the whole area of the cornea. In a normal cornea the image is a perfect circle, but in astigmatism the rings are deformed to ellipses. Deformations are observed also in other irregularities of the shape of the cornea.

Results

Describe the observed subjective manifestations of astigmatism; estimate its angular plane.
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2. Colour vision deficiency

Although most of us agree on the colours we see because we are using similar neural circuits to see them, some people disagree (8% of males and 0.5% of females, respectively). These people have been called colour defective. This defect can result either from inherited or acquired factors. In general, they involve either a loss of one or more of the three cone mechanisms or a change in the absorption spectrum of one or more photopigments within the cones. The adjectives protan, deutan and tritan refer to the long-wavelength, medium-wavelength, and short-wavelength mechanisms, respectively. The suffixes -opia and -omalous refer to a total loss or moderate defect of each of these three mechanisms, respectively. Some people lose two (usually the L and M) or all three cone mechanisms and consequently have no colour vision at all (achromats). It is noteworthy that genes for the L and M cone mechanisms are placed on the X chromosome, whereas the gene for S (blue) is autosomal. A person's colour experience is based on impressions of hue, saturation and brightness.

In everyday life people with colour blindness do not suffer, but they are considered to be unsuitable for some jobs, such as those dealing with traffic, etc. For this reason the examination of colour blindness is of great importance. For the examination of color vision the
Stilling-Hertel or **Rabkin** tables are used:

- **Pseudoisochromasis.** The letters or the numbers differ only by hue, not by brightness or saturation from their surroundings. This differentiation is possible only for trichromats.
- **Pseudoanisochromasis.** The letters or the numbers differ by hue and brightness. Healthy people make differentiation from the hue not from brightness. That is why people with colour blindness read a different letters and numbers.
- **Augmented colour contrast.** Simultaneous colour contrast of the edge is augmented in the normal eye by saturation of opposite colour. For instance, the saturation of red colour is augmented by the green colour of the surroundings. In colour vision defects this contrast is so strong that the opposite colour spreads over the gray area around the letters or numbers.
- **Crape contrast.** The black letters "E" on the dark red field – covered by crape paper – seem to us to have green tones. People with colour blindness see nothing.

Equipment

The tables for colour blindness examination

Protocol

The examined person sits in a quiet room, his back turned to the window. The tables are held at a distance of 100 cm from his/her eyes. The illumination of the tables has to be at least 400 lx. The angle between the visual axis and the table ought to be a right angle (90°). Each exposition lasts 5–15 seconds. Patients with myopia should wear their glasses during examination, but patients with hypermetropia should not. In the event that Stilling-Hertel tables are employed (they are read at a distance of 30 cm from eyes), the rule is the opposite. For the examination of the crape contrast the tables are held 30–40 cm from the eyes. The examiner checks the behavior of the examined person – whether the examined person decides quickly what is in the picture or hesitates and is not sure.

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It is forbidden to touch the tables, to expose them to the sunshine, or to store them in a place with high humidity. Examine the colour vision of several members of your study group.

Results

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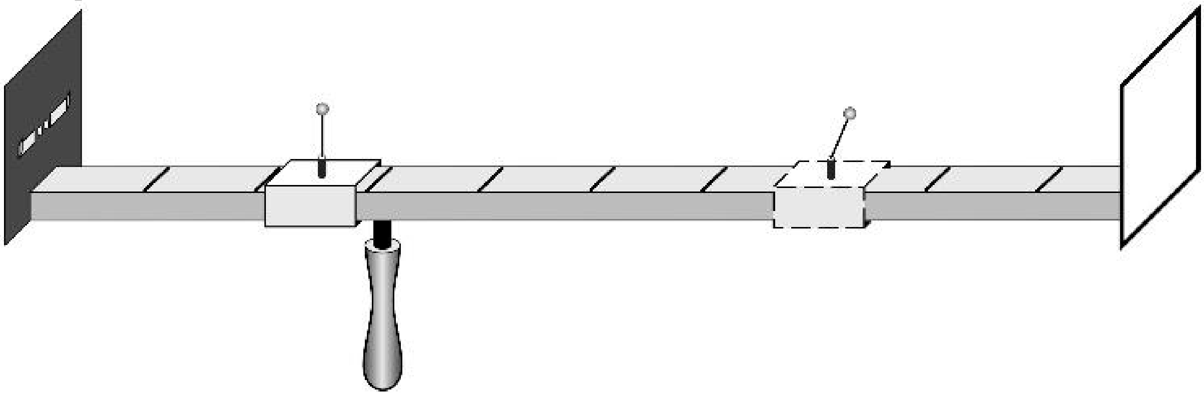
3. Accommodation

The basis of Scheiner's instrument (see Fig. 43) is a one-meter-long ruler equipped with a small shield with two pinholes the distance of which is smaller than the pupil diameter. The pinholes can be separately closed by a pair of valves. The ruler is held up closely to the examined eye with this shield so that one can observe – through the openings – a pin fixed on a sliding rider. Two very narrow light beams come into the eye through the two openings: if the eye had no dioptric system, two almost sharp images of the pins would appear on the retina. Each of the beams, however, passes through a marginal region of the eye's dioptric system and is refracted like by a prism.
When accommodating on the pin observed, the refraction of the dioptric system is such that both images fuse into a single one. At another accommodation (to a near or a distant object) the image is duplicated because the refracting power of the "prisms" has changed.
Note: pictures from the right half of the retina of both eyes, e.g. from the left halves of the visual fields, are analyzed in the right hemisphere. Inversely, pictures from the left half of the retina of both eyes, e.g. from the right halves of the visual fields, are analyzed in the left hemisphere.



Procedure

Estimation of punctum proximum and remotum

Through both pinholes the pin is observed. The pin is slid towards the eye until it starts to appear doubled. At this moment its distance from the eye equals that of the punctum proximum (the near point, i.e. the minimal distance on which the subject can accommodate): it can be directly read on the ruler.
The distance of the punctum remotum (far point) is infinite in persons with normal vision; it can be estimated, using Scheiner's ruler, only in myopic subjects. The procedure is reversed: one starts at a small distance where the subject sees a single pin, and then moves the sliding

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rider towards the ruler end until the pin appears doubled. The punctum remotum is at this distance.

Evidence of accommodation

Two riders are used and placed at distance of 15 and 60 cm. When the distant pin is observed, the near one appears double. When one pinhole is covered, one of the images disappears – note at which side it disappears. When accommodating on the near pin, the far one becomes doubled; after covering one pinhole, one image disappears– note which one disappears.

Results

Punctum proximum:…………cm

Punctum remotum:……………cm

Accommodation to a	Closed pinhole	Disappeared image of pinhole
near pin	right	right / left
	left	right / left
distant pin	right	right / left
	left	right / left

Based on observations of Scheiner's experiment underline the correct side

Explain why during accommodation on one point the other one is doubled.
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Scheiner's experiment: When one pinhole is covered, one of the images disappears. Why?

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4. Visual Field and Blind Spot

The main component of a perimeter is a semicircular arc revolving around the axis connecting its centre and the examined eye. The subject's head is fixed in such a position that the eye is in the centre of the hemisphere traced by the revolving arc. The subject fixes a white mark in the centre of the arc so that the visual axis is identical with that of the perimeter. The arc is equipped with a scale in degrees from the fixation point to both of its ends. The plane of the arc can be set to various angles that can also be read on a scale.

Equipment

Perimeter, charts of visual field, colour pencils, Mariotte's figure, ruler

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Procedure

Visual field

Targets of different colour are moved, in a slow and interrupted fashion, from the periphery to the centre of the perimeter arc; colours are changed in irregular order. At a certain angular distance from the centre the subject starts to see the target without recognizing its colour, because peripheral areas of the retina are colour-blind. When the target is moved nearer to centre, its colour is suddenly recognized. In both instances, read the angle on the arc and transfer its value on the circular ordinate of the chart and on the meridian corresponding to the slope of the arc plane. Mark the points with black (for colourless vision) and the corresponding colours. The examined colours will be blue, yellow, red and green, in planes of 0 (horizontal), 30, 60, 90, 120 and 150 degrees. The points in the chart will be connected by lines of corresponding colours and the polygons thus obtained represent visual fields for different colours and for colourless vision (the largest one). The chart represents, of course, a spherical area projected on a plane.
Define the visual field, monocular and binocular vision. Mark in the chart the visual fields for colourless vision (movement) and for the four colours for one eye.

Location and size of the blind spot

The blind spot may be evidenced by the known experiment of Mariotte: on a black field there is a white small cross on the left and a white round spot on the right. When the cross is observed with the right eye, the white disk disappears at an appropriate distance, because its image falls on the papilla n. optici. The shape and size of the blind spot may be estimated in the following way. With the right eye, one fixes the gaze on a cross drawn on a sheet of paper at a distance of 30 cm (the left eye is closed). One moves the tip of a pencil in an area to the right side from the cross to find places where it is not seen. By moving the pencil in various directions one draws as precisely as possible the borderline between spots where the pencil tip is seen and where not and obtains thus the exact projection of the blind spot. One must not move, of course, either one's head or the paper during this "mapping". **During mapping, do not move the head or paper!**
Define the blind spot and fovea centralis. Draw the shape of the blind spot as precisely as you can. Calculate the actual size (diameter) of the blind spot on the retina (the distance of the retina from the nodal point equals 17 mm) as well as its distance from the fovea (picture). Compare with physiological values.

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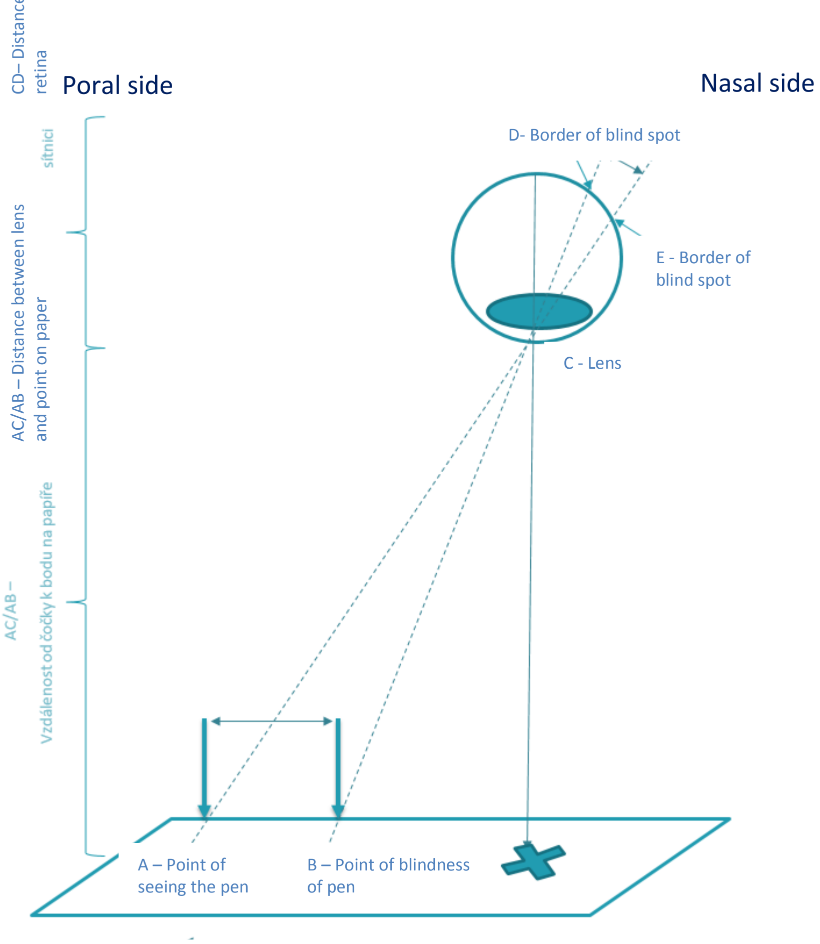

$$\frac{CD}{BC} = \frac{DE}{AB} \rightarrow DE = \frac{AB \cdot CD}{BC} = \frac{17}{300} mm$$

Results

Size (diameter) of the blind spot:……….mm (physiological value: 1.4 mm)

Distance from the fovea:……….mm (physiological value: 4 mm)

Estimation of visual acuity

The letters of Snellen's optotypes are drawn into squares that are divided into 25 smaller squares. The letters have different sizes; the largest ones are in the first line, and in subsequent lines they are smaller and smaller. Each line is marked with a number giving the distance at which the letter is seen at an angle of 5 minutes, i.e. at which it can be read by normal eye. At this distance the typical details of Snellen's types allowing us to discern individual letters are seen at an angle of 1 minute, which is the limit of two-point discrimination in a normal eye.

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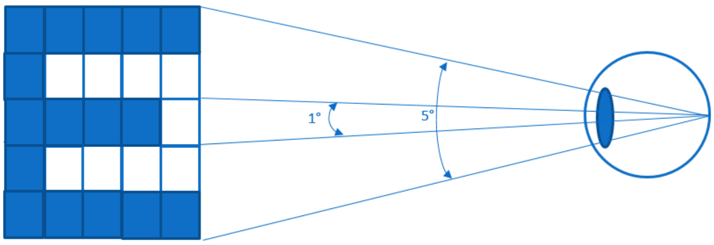

Procedure

Each eye is tested separately. The subject stands at a distance of 5 m from the Snellen table and reads aloud the letters pointed by the examiner. The smallest letters that the subject can read are indicative for estimation of the s.c. visus. The visus is the ratio of the distance from which the tested person could read letters of a given size, i.e. here 5 m, to the distance from which a normal eye can read them which is the number found at the corresponding line of the table. The fraction is not evaluated, i.e. one writes: V = 5/5 (normal eye), V = 5/10 (reduced acuity).

Results

Visus of left eye: Visus of right eye:

Conclusion

Summarize your observations of all used methods.

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