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THE EXPERIMENTAL ANALYSIS OF THE VISUAL FIELD OF PATIENTS WITH STIMULATED PHYSIOLOGICAL PARAMETERS AND PATHOLOGICAL PROBLEMS

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Abstract: *This article's purpose is to observe and analyze the visual field of healthy individuals, before and after different physical stimulations and the visual field of those with different vision disorders. The visual field evaluations were made with an OPTOPOL PTS-910 perimeter, using Threshold strategy. The experiment demonstrates that healthy subjects with stimulated physiological parameters show alterations of the visual field. However, these results don't compare with those of the individuals with visual disorders, these being much more pronounced than the latter.*

Key words: *perimetry, visual field, scotoma, threshold.*

1. Introduction

The visual field is the spatial array of visual sensations available to observation. It is synonym with the term field of view which refers to the physical objects and light sources in the external world that impinge the retina. In other words, field of view is everything that causes light to fall onto the retina. This will be processed by the visual system and result the visual filed.

In optometry visual field test is used to determine whether the visual field is affected by local scotomas or a more extensive loss of vision or a reduction in sensitivity (threshold) [3]. Monocular visual field assures contours, contrast, shapes, movement, light and colors. Binocular visual filed on the other hand forms a three dimensional image. This is called stereoscopic vision.

2. Objectives

This paper's objectives are to analyze how different physical stimuli affect the visual field of healthy individuals. It also evaluates how vision disorders interfere with the results of perimetry [1].

3. Materials and Methods

For testing the visual field there are several methods: there is the campimetry, which is an older method, and the perimetry, more frequently used nowadays.

The perimetry (gr. **Peri** = around, and gr. **Metrein** = to measure) can be static or

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kinetic. Both methods use points of light which are moved inwards in the perimetric bowl until the observer sees them in the case of the kinetic one, or they are flashed onto a white screen at different intensities until they are seen by the observer in the case of the static perimetry [3]. We used the kinetic perimetry, which is a subjective method. It uses the differential perception of light stimuli of different sizes, intensities, colors and display periods [2], [4]. The possible results are shown in Figure 1 and Figure 2. Also, in our investigations very important was to keep the stability of environment (temperature, humidity etc.).

Perimetric examinations were made on seven subjects. Four of them were physiologically stimulated with exercise machines, and three had vision disorders.

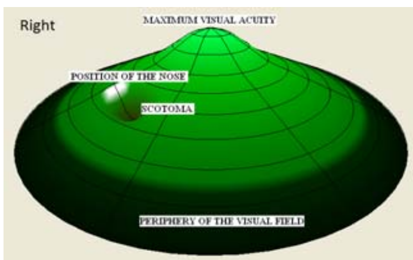

Fig. 1. *A 3D representation of the visual field with all its components:* (*i*) *the white spot indicates the relative position of the nose;* (*ii*) *the black spot indicates a scotoma;* (*iii*) *the black concentric area stands for the peripheral area of the visual field;* (*iv*) *the highest peak indicates an area of hyper visual acuity*

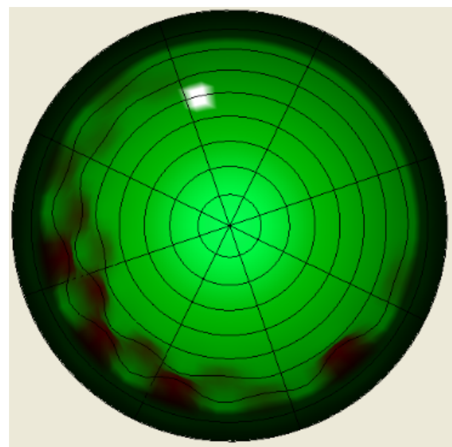

Fig. 2. *3D representation of a visual field affected by peripheral cataract*

3.1. Description of the individuals who participated in the experiment

Subject 1: age: 21, sex: feminine, had undergone a physical exercise on a vibration plate for several minutes.

Subject 2: age: 21, sex: feminine, without refraction disorder, simulated a common mistake made by patients who are tested with the perimeter. She followed the stimuli during the examination.

Subject 3: age: 22, sex: feminine, has myopia of –2.00 spherical diopters at both eyes and a latent strabismus at the right eye, tiredness.

Subject 4: age: 22, sex: masculine, displays a hypermetropia of +0.50 spherical diopters at both eyes and an optically uncorrected divergent strabismus.

Subject 5: age: 23, sex: masculine had undergone a physical exercise on an exercise bicycle.

Subject 6: age: 21, sex: masculine, smoker, excessive coffee drinker, hunger, fatigue, had undergone and intense physical exercise on a treadmill.

Subject 7: age: 61, sex: feminine, shows peripheral cataract at both eyes.

4. Results and Discussions

4.1. Pupillary diameter

As shown in Figure 3, the largest pupil of the right eye was that of subject 3 because of the tiredness and the strabismus. Her body

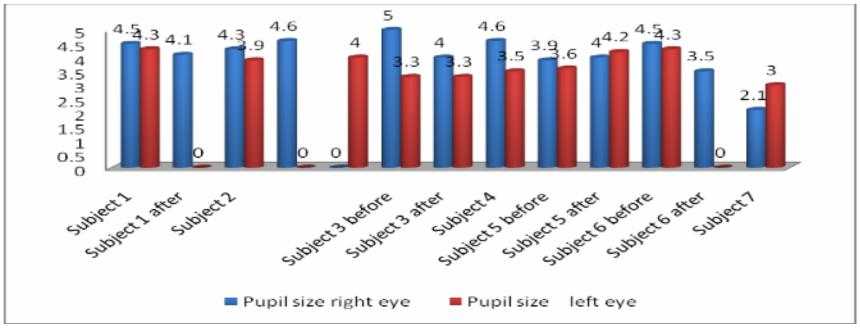

Fig. 3. *Pupillary diameter graph*

tried to compensate this way the decrease of her visual acuity by accepting more light and clarifying the image. The smallest pupil of the right eye was of subject 7 because of her age. Elder people always have smaller pupils because of less muscle movement in the eyes.

At the left eye, the largest pupil sizes were those of subjects 1 and 6 before the exercise simply because of physiological reasons.

The smallest was that of subject 7, again because of the advanced age (Table 1).

Results of the measurement Table 1

	Subject 1 before	Subject 1 after	Subject 2	Subject 2 making a mistake	Subject 2 umber of stimuli	Subject 3 before	Subject 3 after	Subject 4	Subject 5 before	Subject 5 after	Subject 6 before	Subject 6 after	Subject 7
Pupil size right eye	4.5	4.1	4.3	4.6		5	4	4.6	3.9	4	4.5	3.5	2.1
Pupil size left eye	4.3		3.9		4	3.3	3.3	3.5	3.6	4.2	4.3		3
Nr. of shown stimuli RE	216	230	189	219		293	174	183	193	220	211	223	210
Nr. of shown stimuli LE	183		179		211		171	201	197	212	188		203
MD RE	0.32	0.31	0.33	0.2		-0.02	0.1	0.35	0.19	0.15	0.19	0.16	0.02
MD LE	0.3		0.35		0.11		0.06	0.33	0.15	0.12	0.06		-0.14
PD RE	0	0.09	0.09	0.59		5.5	0.41	0.09	0.31	0.57	0.33	0.21	2.17
PD LE	0.1		0.34		0.19		0.38	0.45	0.31	0.41	0.47		2.79
Duration of examination [min] RE	5.07	5.12	4.25	6.3		7.15	4.24	4.17	4.1	4.57	5.06	5.19	5.2
Duration of examination [min] RE	4.1		4.1		6.41		4.09	4.49	4.43	4.42	4.33		5.2

4.2. Displayed stimuli

As we can see in Figure 4 above, the largest number of displayed stimuli was required for the first examination of the right eye of subject 3. Removing the optical correction of the latent strabismus, the eye could not focus well. She needed a certain period for accommodation. For the left eye the maximum number of stimuli was for subject 5, after he had undergone a prolonged physical exercise. This lowered his focusing capacity and therefore his responsiveness. Subject 3 required the smallest number of displayed stimuli for the examination of both eyes after she relaxed and was able to focus better.

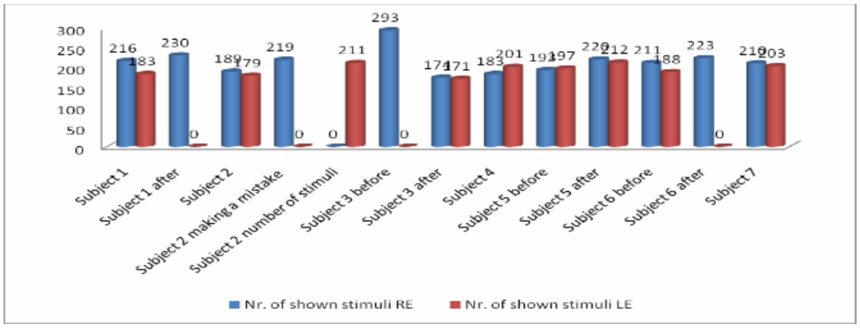

Fig. 4. *The graph of displayed stimuli*

4.3. Mean defect value

Mean defect (MD) is the difference between the average value of light perception levels measured in all tested spots and the normal level value for a certain age interval. For calculating this value there are used only the spots from the visual field which don't present localized defects. It is measured in decibels [dB]. The value 0 means that MD is normal, values higher than 0 show visual field which is better than normal for that particular age, and values beneath 0 means a reduction in light sensitivity. These data are represented in Figure 5.

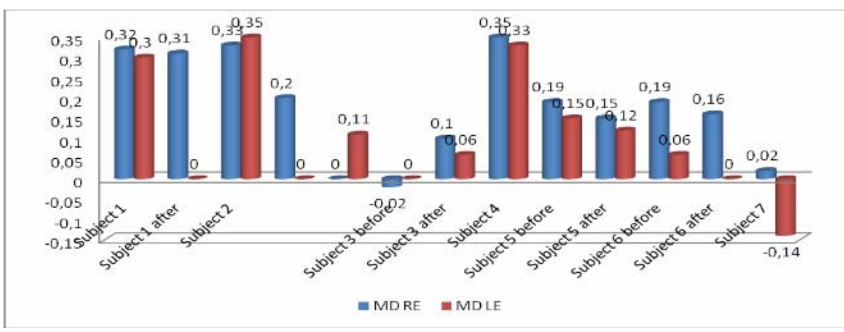

Fig. 5. *The graph of mean defect values*

As it can be observed, the smallest values are those of subject 3, at the right eye, because of the strabismus, and those of subject 7, at the left eye, because of the cortical cataract.

The values closest to 0 are those of subject 7 at the right eye, and those of subjects 3 and 6 at the left eye. Because the majority of the subjects were young, higher values than 0 are very common.

4.4. Pattern defect values

This value gives information about localized defects of the visual field (scotomas). For its calculation all the defects' depths are summed up and divided by the total number of spots examined. Normal values are those closer to 0, with one exclamation mark means warning and with two means alert.

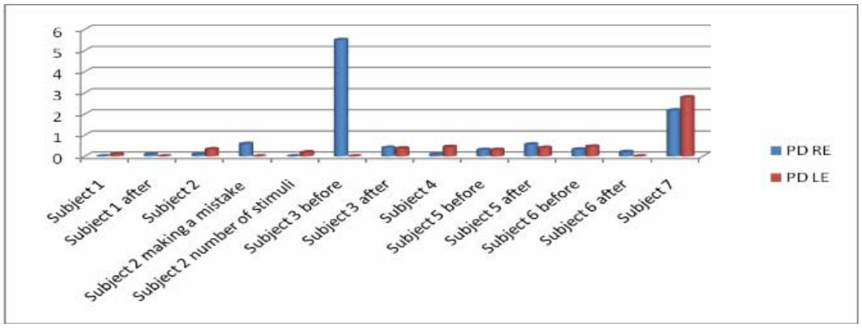

Fig. 6. *The graph of pattern defect values*

Figure 6 shows that values farthest from 0 were those of subject 3 before the accommodation of the right eye. Because of her strabismus she had several scotomas in her visual field. Subject 7 had higher values too due to the cataract. She even had two exclamation marks. The values closest to 0 were those of subject 1 at both eyes because there were no disturbing parameters.

4.5. The duration of the examination

The longest examination duration of the right eye was of 7 min and 15 sec. This was the first examination of subject 3. This means that her strabismus affected her perception of light. For the left eye the examination lasted the longest for subject 2. It was of 6 min and 41 sec. She was tracking the light stimuli and not focusing the spot from the center. The shortest duration was of 4 min and 10 sec at the right eye of subject 5, and for the left eye of subject 1 and 2. The subjects were not stimulated yet and they were more perceptive. All times are represented in Figure 7. Another general conclusion which can be drawn from this diagram is that every subject needed less stimuli for the left eye's testing because the procedure was already tried and understood at the right eye.

5. Conclusions

As we can see from the results, inducing artificially different physiological parameters (as increased heart-rate, increased respiration and blood-pressure, fatigue) we can alter ones visual field. These things can occur in everyday life too, for example at athletes or sportive (Figure 8).

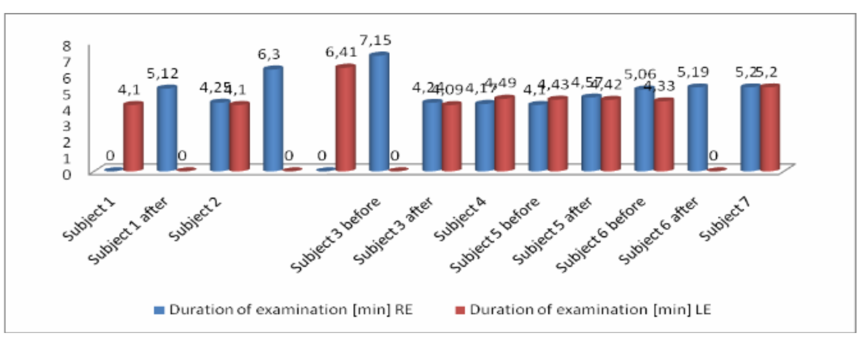

Fig. 7. *The graph of the time necessary for the examination [minutes]*

Fig. 8. *Human subject during perimeter investigations*

Physical exercise decreases visual field, increasing the number of stimuli necessary for examinations. Also subjects who have refractive errors can show different modifications in their visual field.

Strabismus is very important in binocular vision. If not corrected, it can cause loss of vision in different areas of the visual field.

Old age comes with the shrinkage of the visual field especially if the person presents any pathological disorders of the eyes such as a cataract.

Testing the visual field is a very important process in evaluating a person's visual system's health and visual system integrity.

This can show alterations of many kinds considering the disorder which causes it and can lead the examination to the right decision making.

However, it is very important to know the patients health state, life habits and the momentarily body conditions because these can cause parasite modifications in the visual field which can misguide the interpreter.

Acknowledgment

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