CONTRAST SENSITIVITY IN DIABETIC RETINOPATHY

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Abstract: *Contrast sensitivity is one of the components of visual function, which is affected even in early subclinical stages of various eye diseases, including diabetic retinopathy. We present theoretical and practical aspects related to the evolution of contrast sensitivity before and after laser photocoagulation in diabetic retinopathy.*

Cuvinte cheie: *sensibilitate la contrast, retinopatie diabetică, fotocoagulare laser*

Rezumat: *Sensibilitatea la contrast reprezintă una din componentele funcției vizuale, fiind afectată încă din stadii subclinice ale diferitelor afecțiuni oftalmologice, printre care și retinopatia diabetică. Se prezintă aspecte teoretice și practice legate de evoluția sensibilității la contrast, înainte și după fotocoagularea laser în retinopatia diabetică.*

INTRODUCTION

Contrast sensitivity (CS) is defined as the ability to distinguish details at low contrast levels. CS expresses visual analyzer's ability to perceive differences in brightness between adjacent fields. Visual system's ability to realize the difference between objects and background at the level of finest details can be expressed as the maximum level of contrast sensitivity. Used for decades, contrast sensitivity testing was commonly used in experiments and clinical trials. Use of it as routine examination had relatively limited application. Lately it has been reconsidered the importance of contrast sensitivity in assessing visual performance. Its usefulness as a method for examining visual function was demonstrated in situations where impaired visual function is not expressed by changes in usual indicators: visual acuity or visual field.

Contrast is created by the difference between reflected light - luminance - of two adjacent surfaces, rendered by Michaelson's equation:

$$\text{CONTRAST} = \frac{\text{Luminance of bright surface} - \text{Luminance of dark surface}}{\text{Luminance of bright surface} + \text{Luminance of dark surface}}$$

The contrast is usually expressed as a percentage, the fraction being multiplied by 100. If the lowest perceived contrast is 5% contrast sensitivity is 100/5 = 20. If the lowest perceived contrast of a person is 0.6% contrast sensitivity is - SC = 100/0.6 = 170 (figure no. 1). If a person is able to distinguish details in low contrast, sensitivity to contrast is high and vice versa.

Figure no. 1. Levels of contrast

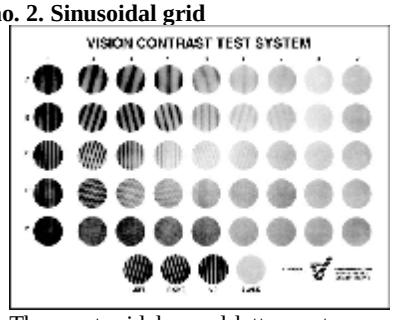
100%	25%	10%	5%	2.5%	1.25%	0.6%

Contrast sensitivity testing can be done using systems of letters, figures or grids that are in the form of boards or video monitors. Testing can be done under photopic, mesopic and scotopic conditions associated with glare sensitivity tests.

Sinusoidal grids are presented as black and white alternate lines whose intensity varies sinusoidally, the visual system decoding the scenes in sinuous language (figure no. 2).

Determination of contrast sensitivity consists in testing these sinusoidal networks - the only real stimuli perceived by the brain. The retina acts like a microcomputer that decomposes the projected images into a sum of sinusoidal networks with variable contrast.

Figure no. 2. Sinusoidal grid



The most widely used letter systems are Pelli-Robson (figure no. 3) and Regan tests.

Figure no. 3. Pelli-Robson test

Pelli-Robson test advantages:

- is easily understood by patients
- no special examination conditions required

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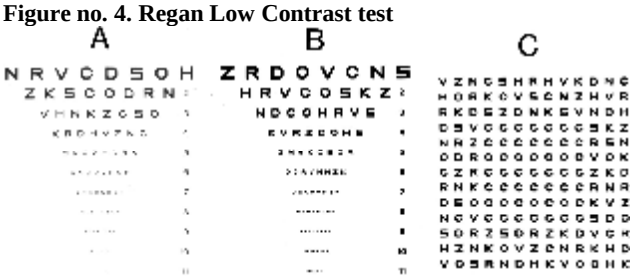
- is carried out quickly (up to 8 min.)
- is quickly and easily to interpret, requiring no graphic representation
- relatively low price

Disadvantages:

- explore the low frequency of contrast

Regan Low Contrast presents three boards, with decreasing size of the letter, the lowest being equivalent to 6/3 Snellen VA, contrast decreases 96%, 7%, 4%. The test is not affected by refraction, is mostly used to assess the progression of cataracts (figure no. 4).

Figure no. 4. Regan Low Contrast test



CASE REPORT

N.M., a 67-year old female presents with decreased visual acuity.

Past medical history:

-Type 2 diabetes mellitus treated with insulin

-Diabetic retinopathy

Ophthalmologic exam:

-BCVA RE=0.5; LE=0.5

-IOP RE=17mmHg; LE=16mmHg

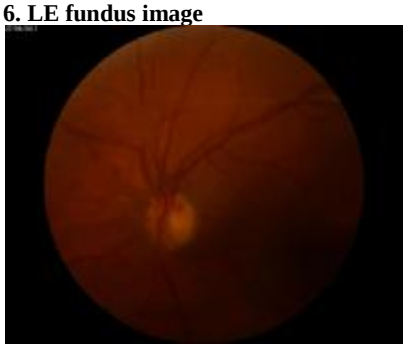
-CSRE=1,35uLog; CSLE=1,20uLog; CSBE=1,45uLog

-Anterior segment: normal

-Fundus examination: hemorrhages and few hard exudates diseminated throughout, neovascularisation at disc, mild fibrovascular proliferation LE>RE (figures no. 5,6).

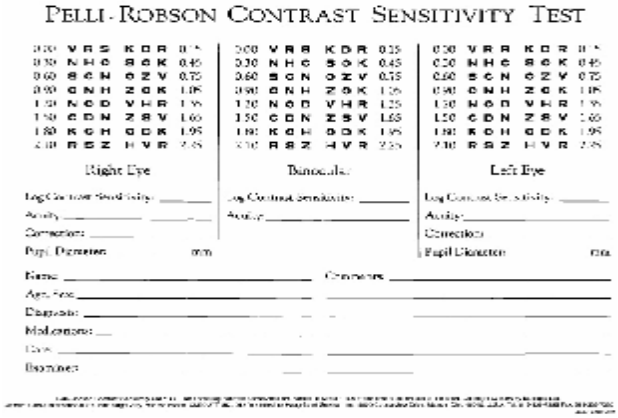
Figure no. 5. RE fundus image

Figure no. 6. LE fundus image



To examine contrast sensitivity we used Pelli-Robson test with associated CS chart (figure no. 7).

Figure no. 7. Pelli-Robson contrast sensitivity chart



Because the patient had a moderate stage of proliferative diabetic retinopathy, we decided to initiate laser photocoagulation treatment. Focal laser photocoagulation in the macular region areas of interest was performed first, then laser panphotocoagulation divided into four sessions.

Three months post laser treatment check:

-BCVA RE=0,6; LE=0,6

-IOP RE=18mmHg; LE=17mmHg

-CSRE=1,35uLog; CSLE=1,35uLog; CSBE=1,50uLog

-Fundus exam: regression of hemorrhages, disappearance of neovascularization (figures no. 8,9).

Figure no.8. RE post laser treatment image

Figure no. 9. LE post laser treatment image

Diabetic retinopathy affects all components of visual function. Visual acuity is variably altered by macular damage, decreasing progressively as macular edema worsens. Visual field shows relative or absolute scotomas corresponding to non perfused areas. Colour vision is disrupted since early stages, blue-yellow axis dyschromatopsia is due to the selective depression of the sensitivity of cones that perceive blue colour. Contrast sensitivity is also affected early, even if visual acuity remains good and there is no ophthalmoscopic evidence of changes in the retina. The mechanism of loss of contrast sensitivity is still not known well although hyperglycemia-related changes of the retina, which result in accumulation of abnormal fluid, have been suggested. Some studies showed that

loss of contrast sensitivity correlates with enlargement of the foveal avascular zone.

Contrast sensitivity is the first of visual functions affected and the last to return to normal in neuro-ophthalmologic disorders. It is an important aspect of visual function and is even more important for ordinary daily tasks than visual acuity. In our case there was an improvement of contrast sensitivity after laser photocoagulation correlated with a decrease in central retinal thickness (reduced macular edema).

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