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Visual function alterations in essential tremor: A case report

David P. Piñero*,†,‡, Begoña Monllor*, Vicenta Moncho*,
Vicent J. Camps* and Dolores de Fez*,§
*Grupo de Óptica y Percepción Visual (GOPV)
Department of Optics, Pharmacology and Anatomy
University of Alicante, Spain

†Department of Ophthalmology (OFTALMAR)
Medimar International Hospital, Alicante, Spain

‡Foundation for the Visual Quality
(Fundación para la Calidad Visual, FUNCAVIS)
Alicante, Spain
§dolores.fez@ua.es

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Our purpose is to report alterations in contrast sensitivity function (CSF) and in the magno, parvo and koniocellular visual pathways by means of a multichannel perimeter in case of an essential tremor (ET). A complete evaluation of the visual function was performed in a 69-year old patient, including the analysis of the chromatic discrimination by the Fansworth–Munsell 100 hue test, the measurement of the CSF by the CSV-1000E test, and the detection of potential alteration patterns in the magno, parvo and koniocellular visual pathways by means of a multichannel perimeter. Visual acuity and intraocular pressure (IOP) were within the ranges of normality in both eyes. No abnormalities were detected in the fundoscopic examination and in the optical coherence tomography (OCT) exam. The results of the color vision examination were also within the ranges of normality. A significant decrease in the achromatic CSFs for right eye (RE) and left eye (LE) was detected for all spatial frequencies. The statistical global values provided by the multichannel perimeter confirms that there were significant absolute sensitivity losses compared to the normal pattern in RE. In the LE, only a statistically significant decrease in sensitivity was detected for the blue-yellow (BY) channel. The pattern standard deviation (PSD) values obtained in our patient indicated that there were significant localized losses compared to the normality pattern in the achromatic channel of the RE and in the red-green (RG) channel of the LE. Some color vision alterations may be present in ET that cannot be detected with conventional color vision tests, such as the FM 100 Hue.

§Corresponding author.

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1. Introduction

Essential tremor (ET) is a neurological disorder of unknown cause. Its most recognizable clinical feature is an 8–12 Hz kinetic tremor of the arms, which often is later accompanied by head and voice tremors.[1] Recent histopathological and neuroimaging studies in ET have demonstrated distinctive structural changes, including neuronal loss.[2] These changes have been suggested to be in relation with some nonmotor features that has been described in ET, such as disturbances of olfaction, hearing impairment and an altered color vision.[3] ET is distinct from Parkinson's disease (PD), although often is misdiagnosed as such because both conditions share some signs and symptoms.[1] Some authors have reported color vision alterations in both type of conditions,[3,4] whereas others have concluded that color vision abnormality did not seem to be a feature of ET.[5,6] This case report shows a complete evaluation of the visual function in a patient with ET, including the analysis of the chromatic discrimination by the Fansworth–Munsell 100 hue test, the measurement of the contrast sensitivity function (CSF) by the CSV-1000E test, and the detection of potential altered patterns in the magno-, parvo- and konio-cellular visual pathways by means of a multichannel perimeter.[7,8]

2. Case Report

Our patient was a 69-year old woman with diagnosis of ET that has been treated during 3 years before our visual examination. The right eye (RE) was pseudophakic (monofocal aspheric intraocular lens) with manifest refraction of (+1.00) (−1.50) × 115° and corrected distance visual acuity (CDVA) of 20/25. The left eye (LE) was a phakic eye with a transparent crystalline lens, manifest refraction of (−1.50) (−0.75) × 90°, and CDVA of 20/20. Intraocular pressure (IOP) was 15 mm Hg in both eyes and no abnormalities were detected in the fundoscopic examination. Likewise, no alterations were detected in the examination of the macular structure by optical coherence tomography (OCT).

The results of the color vision examination (FM 100 Hue) were within the ranges of normality. Specifically, the total error and the red-green (RG) and blue-yellow (BY) partial errors showed normal values. Only the error value in the R–G axis was above the mean value for the age group of the patient, although it was near the superior limit of this normative range. Regarding achromatic contrast sensitivity evaluation, a decrease in the CSFs for RE and LE was detected for all spatial frequencies, with values out of the normality range defined by the manufacturer (Fig. 1).

Besides these tests, visual perimetry was performed with a multichannel perimeter[7] that determines in different spatial locations the retinal detection thresholds, but analyzing separately the three sensorial afferent pathways of the visual system (magno, parvo and konio). This can be achieved by changing the spatio-temporal and chromatic design of the stimulus. Considering previous experiences evaluating magno-, parvo- and konio-cellular pathways in PD and chromatic contrast sensitivity in retinal diseases, we selected the

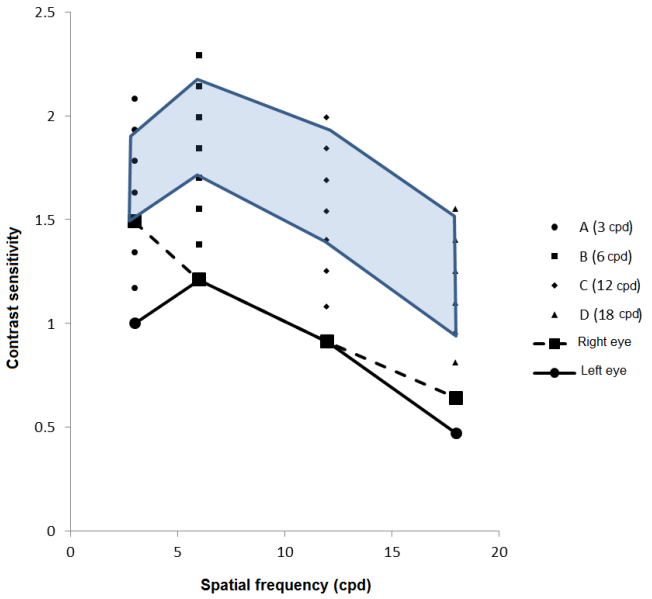

Fig. 1. Achromatic CSF obtained by means of the CSV-1000E test for both eyes. The shadowed zone represents the range of normality.

following channels and frequencies to be examined[9,10]:

— Achromatic channel (A): 0.5 cycles/° and 24 Hz
— Parvocellular red-green channel (RG): 0.5 cycles/° and 0 Hz
— Koniocellular blue-yellow (BY) channel: 0.5 cycles/° and 0 Hz.

The results of this test for RE and LE are displayed in Fig. 2. The colorimetric principles of the test design (spatio-temporal characteristics in the Derrington-Krauskopf-Lennie (DKL) opponent modulation space), the psychophysic method used during the measurement procedure (interleaved stepwise threshold algorithm) and the algorithms defining the statistical variables of the test have been previously described in detail.[7,8]

3. Discussion

The performance of visual perimetries is a very useful clinical tool to evaluate the status of retina as well as of the visual pathways from the retina to the visual cortex. The possibility of analyzing the visual function for the magno-, parvo- and konio-cellular pathways is a relatively new tool that allows the clinician to detect incipient alterations in each of these visual pathways that could not be detected in a conventional perimetric exam. The multichannel perimeter measures the detection thresholds in a horizontal field of $60 \times 40°$, centered at the fovea, and at a viewing distance of 25 cm.[7] The stimuli used were sinusoidal gratings of variable spatial and temporal frequency, variable chromaticity, with a size of 5°, round shape and smooth edges. This report shows the first use of this type of perimeter for evaluating the visual function in a neurological disorder.

The evaluation of the achromatic channel in our ET patient showed a global decrease in sensitivity in RE involving almost all the nasal hemifield, including the fovea, and extending to the superior hemifield at the temporal side (Fig. 2, top). The localized defect map confirmed that only the losses were statistically significant compared to the normal healthy population[7,8] in the nasal-superior quadrant. In contrast, no sensitivity losses were detected in the achromatic channel of the LE except for a specific point located at the infero-temporal

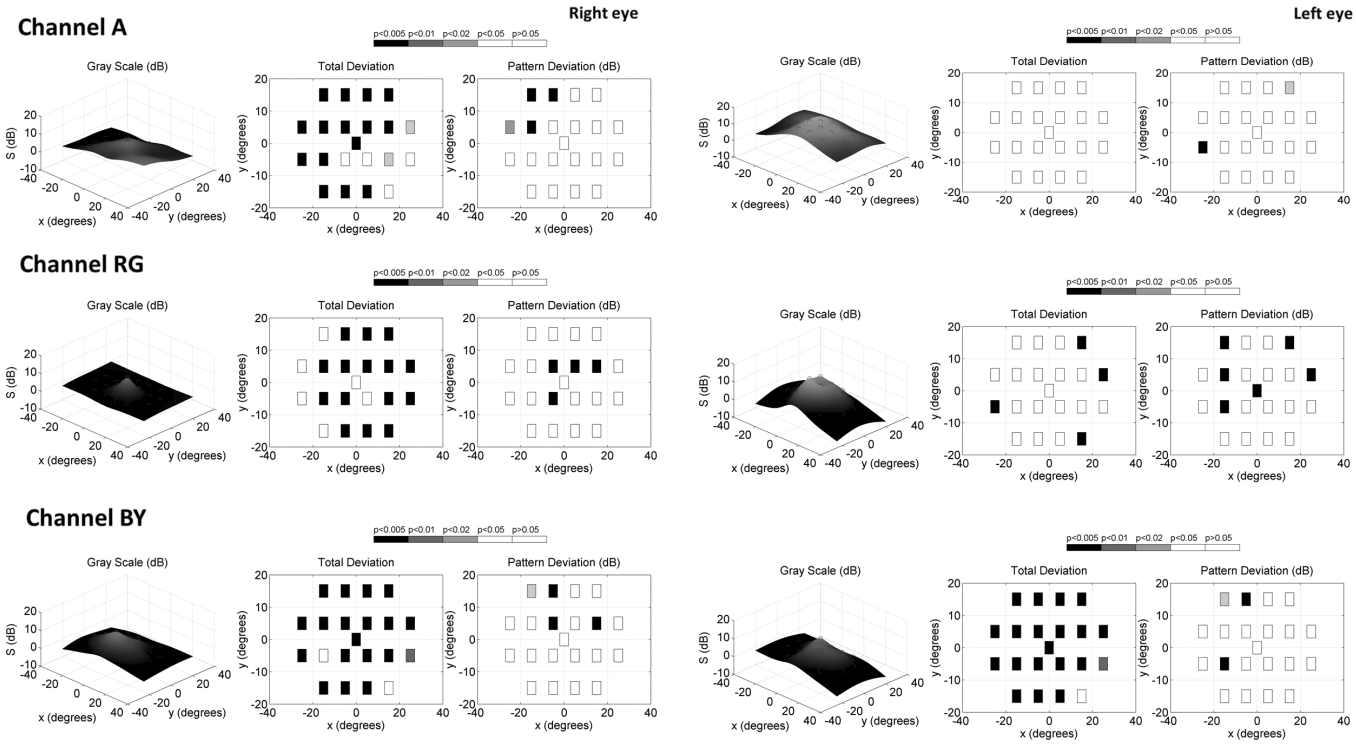

Fig. 2. Results obtained with the multichannel perimetry. Top: achromatic channel; center: RG channel; bottom: BY channel. Left: right eye; right: left eye. In each map of each eye the sensitivity (left), total deviation (center) and pattern deviation (right) are shown.

quadrant. Regarding the RG channel, the RE showed global losses in almost all visual field, except for the nasal periphery (Fig. 2, center). Significant localized visual defects were found in almost all areas of the parafoveal zone in RE and in some points of the superior hemifield of the LE, including the fovea. The BY channel showed global sensitivity losses in almost all visual field of both eyes, with only significant localized losses in the superior hemifield (Fig. 2, bottom). All these results suggest that some alterations in the RG and BY visual pathways may be present in cases of ET compared to the normal healthy population.[7]

The statistical global values provided by the multichannel perimeter (Table 1) confirm that there were significant absolute sensitivity losses compared to the pattern in RE. However, the same situation is not observed in the LE, as variations in the achromatic and RG channels were small and not statistically significant. In this LE, only a statistically significant decrease in sensitivity was detected for the BY channel that was of the same magnitude than that occurring in the RE. The pattern standard deviation (PSD) values obtained in our patient indicated that there were significant localized losses compared to the normality pattern in the achromatic channel of the RE and in the RG channel of the LE.

The results obtained in the multichannel perimetry for the achromatic channel were relatively consistent with the degradation of the achromatic contrast sensitivity detected for almost all spatial frequencies with the CSV1000E test. Specifically, the spatial frequency tested (0.5 cycles/°) with the multichannel perimeter did not show exactly the same values than the CSV1000E test, but it should be considered that the multichannel perimeter evaluates all the retina and the stimulus flickers at 24 Hz, while with the CSV1000E test the stimulus had temporal frequency 0 and is localized at the center of the visual field. Our results in this ET patient are similar to those reported by Armstrong[11] in PD, with more deterioration of the visual function for intermediate and/or high spatial frequencies. To date, there are no other studies to compare with evaluating the achromatic contrast sensitivity in patients with ET.

Finally, the specific test to evaluate the color vision (FM 100 Hue) failed to detect color vision anomalies in our patient and this suggests that color vision anomalies at parafoveal and peripheric level may be present in ET which cannot be detected in all cases with a conventional color test based on the visualization of a test placed at the center of the visual field. This may be explained because previous series evaluating the color vision in ET patients have not detected anomalies.[5,6] The decrease in sensitivity found in our patient in the BY channel is consistent with the results obtained by Diederich *et al.*[12] and Abedul *et al.*,[13] but in PD.

In conclusion, some color vision alterations may be present in ET that cannot be detected with conventional color vision tests, such as the FM 100 Hue. Future studies should investigate if these color vision alterations detected by means of a multichannel perimetry ATD may be used for the detection of incipient stages of this neurological disorder. Likewise, more studies should be conducted to evaluate the potential of multichannel perimetry for detection and analysis of other types of neurological diseases.

Table 1. Statistical values obtained with the multichannel perimeter. For each mechanism evaluated, the values of the medium defect (MD) and pattern standard deviation (PSD) are shown as well as the statistical significance (p-value) of the comparison with the normal healthy pattern.

	Achromatic		RG		BY	
	RE	LE	RE	LE	RE	LE
MD	−4.7	0.18	−3.6	−0.55	−5.6	−5.8
p-value MD	0	0.52	0	0.65	0	0
PSD	2	1.4	2.3	1.7	1.8	1.6
p-value PSD	0.04	0.26	0	0	0.23	0.5

Patient Consent

The patient has consented to the submission of the case report for submission to the journal.

Conflict of Interest

The authors have no financial or proprietary interest in a product, method, or material described herein.

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