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The role of long-term clinical studies in defining DMTs' profile

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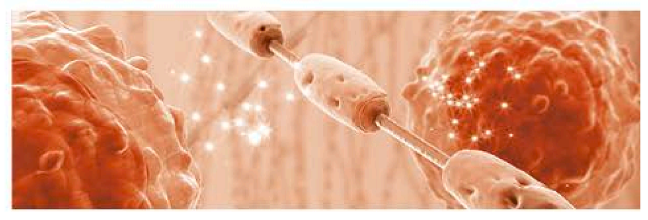

THE USE OF AUTOMATIC CLASSIFIERS IN MULTIFOCAL ELECTRORETINOGRAMS RECORDINGS FOR DIAGNOSING MULTIPLE SCLEROSIS

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INTRODUCTION

Purpose

The objective of this work is to investigate the diagnostic capacity of multiple sclerosis (MS) in early stages of the disease from the analysis of multifocal electroretinogram (mfERG) recordings using artificial intelligence tools.

The mfERG

The multifocal electroretinogram (mfERG) technique allows to obtain objective and qualitative measurements regarding the functioning of the retina excited with different types of visual stimuli, and was developed for the simultaneous detection of the electrical activity from specific sectors of the retina.

METHOD

Subjects Database

mfERG signals of both eyes in 10 subjects (F:M=7:3) with early diagnosis (inferior to 6 months) without previous history in optic neuritis and 6 healthy controls (F:M=3:3) were used. The age (mean ± SD) was 45.60 ± 7.38 years for the patients and 35.33 ± 10.63 years for the controls.

Recordings were acquired in the Ophthalmology Service of the University Hospital Miguel Servet (Zaragoza, Spain).

The recordings

The first order mfERG kernel was obtained according to the ISCEV standard 5 (2011) using a Roland Retiscan system. The stimulus configuration used was the 61 hexagon array (Fig. 1) scaled with eccentricity (the area of the hexagons increases towards periphery to compensate for lower cone density).

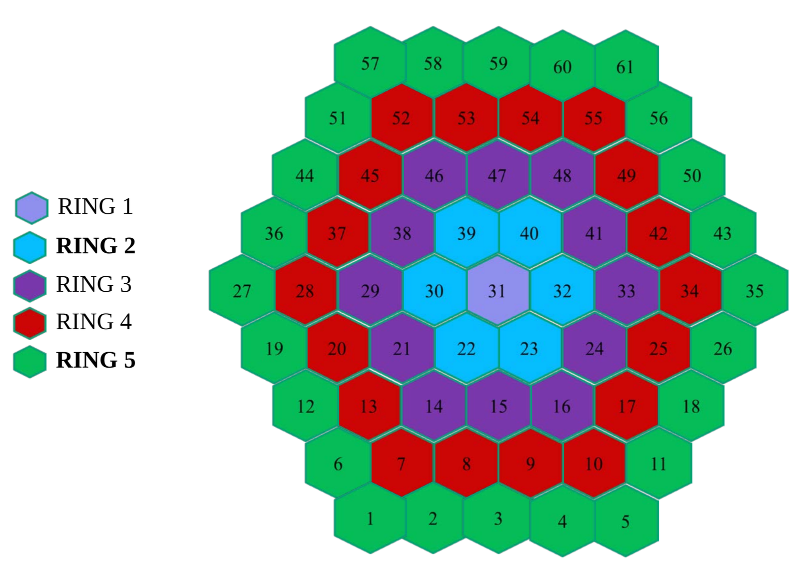

Fig. 1

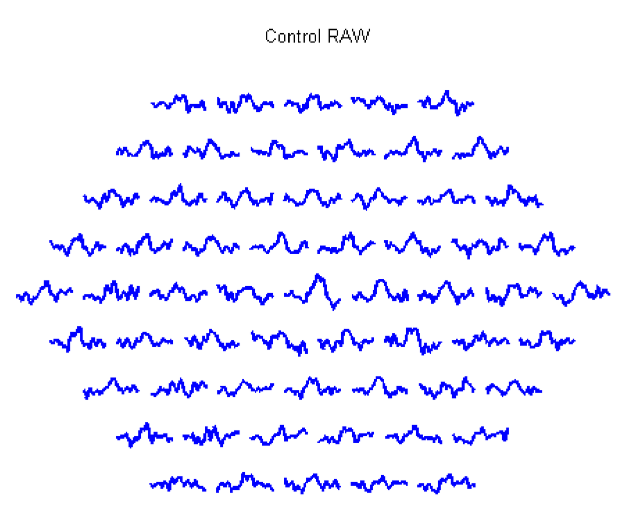

Fig. 2

The frame rate was 59.81 Hz, the amplifier gain 10^4 and bandwidth 10-200 Hz. The signals were digitized with a sampling rate of 1017 samples/s. The number of samples in each recording was 84 (length 82.61 ms).

mfERG record grouping

Individual mfERG responses for the 61 hexagons (Fig. 2) were grouped into five concentric rings centered on the fovea for analysis (Fig. 1):

- RING 1 (R1): 0-1.75º, 16 degrees^2, 1 hexagon.
- RING 2 (R2): 6.25º, 23 degrees^2, 6 hexagons, perifoveal ring.
- RING 3 (R3): 11.5º, 36 degrees^2, 12 hexagons.
- RING 4 (R4): 17.85º, 51 degrees^2, 18 hexagons.
- RING 5 (R5): 25.3º, 69 degrees^2, 24 hexagons.

Parameters definition

- P1 peak was the maximum in the 19 to 50 ms interval (Fig. 3).
- P1 latency (LP1) was time from the stimulus onset to P1 peak (Fig. 3).
- The latencies of wave P1 in rings R2 and R5 are computed and used as inputs to an automatic classifier.

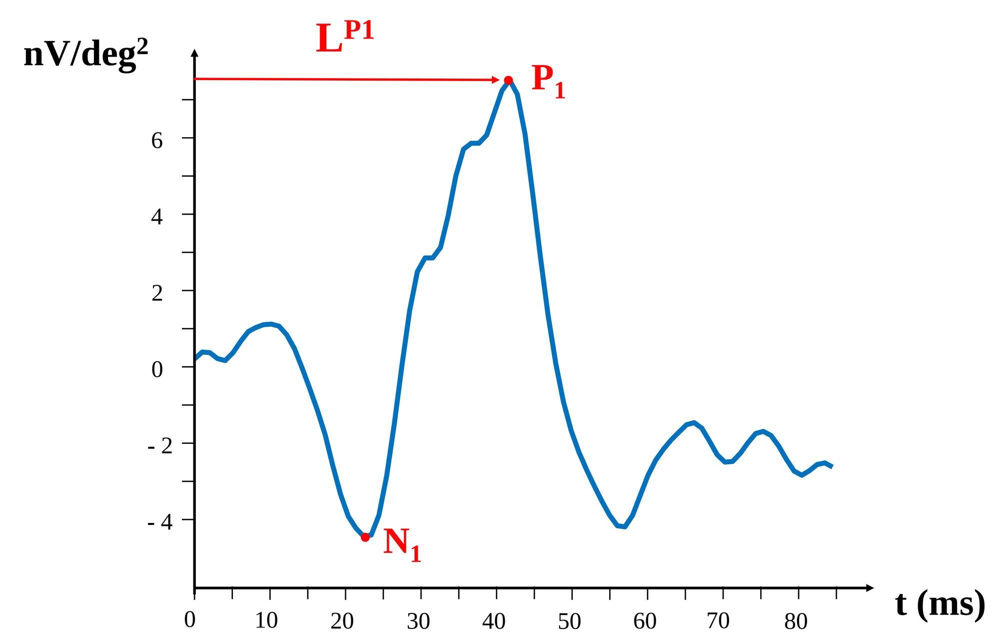

Fig. 3

RESULTS

Latency values of P1 wave in controls and MS. Area under the curve (AUC).

Results for L^{P1}			
	Controls	MS	AUC
Ring 2	44.08 ± 1.82	42.33 ±2.62	0.69
Ring 5	41.05 ±2.55	42.53 ±2.21	0.69

Confusion matrix using an automatic classifier: cuadratic Support Vector Machine. Training method: leave-one-out cross-validation.

Results for L^{P1}		
	Predicted Controls	Predicted MS
True Controls	7	5
True MS	2	18

This method obtains a sensitivity of 0.90 and specificity of 0.58, accuracy= 0.78.

DISCUSSION

This result suggests that automatic classifiers are applicable for the assessment of patients in the first stages of MS (without optic neuritis symptoms).

Complementary mfERG analysis and processing methods should be investigated to improve the results.

LITERATURE

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Acknowledgments

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