

Scotopic Adapted Full-Field Electroretinogram Effect in Young Malay Adults

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Abstract: The full-field electroretinogram (ffERG) is commonly used as an electrophysiological test of retinal function. The purpose of the study was to investigate the electrophysiology activity of the photoreceptors in the retina scotopic adapted full-field electroretinogram in young Malay adults. Thirty-two normal young Malay adult subjects, mean age 21.72 ± 0.88 years old, mean of refractive error $-1.07 \text{ D} \pm 1.45 \text{ D}$ participated. Standard protocol from International Society of Clinical Electrophysiology of Vision (ISCEV) 2008 ERG Standard was applied. The mean, standard deviation and median of amplitude (μV) of rod a-wave (-9.26 ± 5.76 , -8.11) and rod b-wave (230.16 ± 157.28 , 204.45), and the latency time (ms) of rod a-wave (29.27 ± 3.90 , 28) and rod b-wave (87.58 ± 10.74 , 86) were shown in descriptive data. We found the normal sample of young Malay adult data that can be used on Malay population and comparable to other ethnic around the world.

Keywords: dark adapted; electrophysiology; Full-Field Electroretinogram; Malay population; scotopic adapted.

I. INTRODUCTION

Electroretinogram (ERG) is a device in measuring the electrical activity of the cells located in the retina. There were two common types of ERG; full-field ERG (ffERG) and a multi-focal ERG (mfERG). Both were used in the evaluation of the retinal cell functions but had different manners of detection and values. Dark-adapted ffERG was used to investigate the rod photoreceptors as they were activated during scotopic condition. The values recorded by scotopic can be affected by many factors such as; age factor, the ethnicity, the ocular parameters e.g. axial length and pigmentation and the test set-up such as the electrodes and the adaptation time.

Base on previous study, most study tested by ERG were mainly performed on Caucasian population in Europe and America, while the Japanese and Chinese were the population in Asia [1]. Presently, the study focused on the ffERG parameter on Austronesian people in particular Malay (Melayu) population. Melayu or Malay was an ethnic group of Austronesian peoples that now predominantly inhabiting Peninsular and Borneo of Malaysia, Indonesia, Singapore, Brunei, Southern Philippines, Southern Burma, Southern Thailand, Cambodia, Vietnam and minorities outside South East Asia such as in South Africa, Sri Lanka, and Western Australia [2].

The anatomy of ocular was reported to be significant different between Asian and Caucasian ethnic [3]. There were a few ocular characteristics that differentiate between the Malays from their counterpart from Asia. Study by Cheung et al. [4] found both retinal arterioles and venules in Malay children less narrower compare the Chinese and Indian children, therefore the value of ffERG might be different in young Malay adults population.

II. METHODOLOGY

This study was conducted at the Advanced Electrophysiology for Vision Laboratory (AEVo Lab), Optometry Clinic, Universiti Teknologi MARA (UiTM), Malaysia. Thirty-two of normal Malay young adult subjects from age 18 to 24 years old, were selected via simple convenience sampling. All the subjects resided around the Klang Valley. Even though all subjects were resided in the Klang Valley, they had been born in different places all over Malaysia, where they were raised and stayed longer at their hometown than their residency in Klang Valley. The ethnicity of the subjects was confirmed by simple verification from their national identity card. The parentage of the subjects was confirmed. Both parents of the subjects were ensured to be Malays to enable them to be included in this study. The ethical consideration had been approved by the Universiti Teknologi MARA (UiTM), and followed the tenet of the Helsinki Declaration.

Prior to the investigation using the ffERG, the subjective refraction, slit lamp examination, funduscopy, intra-ocular pressure measurement, binocular vision testing and color vision testing were conducted on all subjects. The exclusion criteria were color vision defects, binocular vision problems, ocular diseases, previous or current medication intakes e.g. anti-malarial medication that may cause retina toxicity and systemic diseases that may jeopardized the retinal integrity such as hypertension and diabetes.

The ffERG investigation started with the dilation of both pupils of the subjects using 2 drops of 1.0% Tropicamide (Mydracyl; Alcon Laboratories, USA) instilled in 5 minutes gap between each drop. Before each of the ffERG examination took place, the machine had been set to calibrate automatically. The Espion™ (Diagnosys LLC Littleton, MA) with optoelectronic electrodiagnostic system using light-emitting diode flash stimulation was used. While waiting for the dilation to take effect, the subjects were prepared for the ffERG procedures by follow the ISCEV Standard.

Then, the subjects were dark-adapted for 20 minutes as preparation for scotopic ffERG. No lights were detected in the dark room during this procedure. Lux meter had shown 0 cd/m² throughout the adaptation session. The ffERG protocols for scotopic stimulation followed the ISCEV Standard 2008, Marmor et al. (2008), which include the dim flashes of light intensity 0.01 cd.s.m⁻² presented for every 10 seconds until 4 comparable artifact-free ERG waveforms were obtained and averaged (the rod ERG). Stimulus intensity was increased to 3 cd.s.m⁻² and single flashes were presented every 15 seconds until 4 similar artifact-free ERG waveforms were obtained and averaged.

III. RESULTS

From the scotopic ffERG result, the mean, standard deviation, median, range 50th and 75th percentile for parameter of rod a-wave amplitude and latency time, rod b-wave amplitude and latency time, mixed a-wave amplitude and latency time, mixed b-wave amplitude and latency time, oscillatory potential were summarized in Figure 1. So, comparing the previous study done by Fulton et al. [5] focused on median of rod b-wave amplitude for two different population in Boston, USA and Toronto, Canada, were 253 μ V and 231 μ V respectively, while the latency time were 79 ms and 114 ms respectively, there were large different in amplitude between Boston and young Malay population, and applied also for latency time between Toronto and young Malay population. The different pattern also noted by Parvaresh et al. [6] on Iranian population, large different in amplitude of a-wave and b-wave also found, while small different in latency time for a-wave and b-wave comparing the young Malay population.

ffRG Parameters	Mean and SD	Median	Range	50 th Percentile	75 th Percentile
Rod a-amp (μ V)	-9.26 $\pm$ 5.76	-8.11	32.82	-8.11	-5.96
Rod a-lat (ms)	29.27 $\pm$ 3.90	28.00	15.00	28.00	31.00
Rod b-amp (μ V)	230.16 $\pm$ 157.28	204.45	1256.25	204.45	248.73
Rod b-lat (ms)	87.58 $\pm$ 10.74	86.00	48.00	86.00	93.75
Mixed a-amp (μ V)	-78.50 $\pm$ 42.73	-176.20	216.11	-176.20	-155.28
Mixed a-lat (ms)	15.83 $\pm$ 1.42	16.00	9.00	16.00	16.00
Mixed b-amp (μ V)	288.00 $\pm$ 78.20	275.65	338.20	275.65	324.30
Mixed b-lat (ms)	39.70 $\pm$ 4.25	40.00	18.00	40.00	41.75
OP1 implicit time	17.67 $\pm$ 0.70	18.00	4.00	18.00	18.00
OP2 implicit time	24.38 $\pm$ 0.58	24.00	2.00	24.00	25.00
OP3 implicit time	27.67 $\pm$ 3.08	25.00	7.00	25.00	31.00

amp = amplitude; lat = latency time; OP = oscillatory potential

Figure 1: Summary of Scotopic ffERG findings

ffRG Parameters	Mean	Median	Range	50 th Percentile	75 th Percentile
Age (Years old)	21.72 $\pm$ 0.88	22.00	4.00	22.00	22.00
Refractive Error (D)	-1.07 $\pm$ 1.453	-0.88	6.00	-0.88	+0.25
Axial Length (mm)	25.02 $\pm$ 1.52	24.71	7.40	24.71	25.71
Pupil size (mm)	7.70 $\pm$ 0.79	8.00	3.00	8.00	8.00
Iris pigment	32 subjects on scale 5 – Light brown to dark brown				
Exposure time to sunlight	Average more than 5 hours per day				

Figure 2: Demographic analysis of subjects

The electrical potential in scotopic adapted ffERG have been depend on a few factors like age, refractive error, axial length, pupil size, iris pigment and exposure time to sunlight (Figure 2). The scotopic electrophysiology activities may perhaps compromise by the special variations in the specific population, and then reflected back on the population characteristics. As for pigmentation, all 32 subjects had been examined using Martin-Schultz scale. It is interesting to note here that all the subjects were Scale 5 in the examination. Meanwhile, subjects had also been asked verbally on their exposure time to sunlight. All subjects had identified their average exposure time to sunlight per day is more than 5 hours.

IV. DISCUSSION

ISCEV recommended every laboratory that set up an electrophysiology unit like ERG should establish their own normative values for their population. The reason given was that the ERG values were affected by many different factors and every laboratory had their own settings.

While ISCEV touch this issue as a technical issue, it is also a good opportunity to believe that the value differences in ffERG can be due to the ethnic nature and physiognomies, not only in technical aspect. Currently, this is the first study on normal scotopic-adapted value on Malay ethnic and the values considered important. The Malays that we studied were from the origin of Deutero Malay, in which HUGO had claimed to be the ancestors or contributors in creating other Asian population such as Chinese and Japanese [7].

Meanwhile, there were various 'external factors' that contribute to the ffERG in the current study. This can be demonstrated by comparing the young Malay adults population with Caucasian adults from Toronto, Canada, Boston, USA, and Iranian. We acknowledge that the different value among these study might be influenced by geographical and life style different, age of the subjects, refractive error, axial length, maximum dilated pupil size during examination, the iris pigmentation and the exposure of subjects to sunlight were the factors that can be contributed the ffERG value within the different population around the world. We believe that these were the special traits that occurred to the young Malay population, hence there will be no big changes in the ffERG values for young Malay population whether it is confirmed in the same or different lab if both were using the same standard and equipment.

V. CONCLUSION & RECOMMENDATION

This study provide the scotopic adapted on electrophysiology activities ffERG values for young Malay adults that can be used clinically that involve Malay population, suggesting individuals with pathological may consequence in incorrectly abnormal values if these parameter are not reflected in the normative database for Malay population. Besides, we had also recognized the factors that may contribute to the differences electrophysiology values in young Malay adults population, such as the age factor, refractive error, axial length, iris pigmentation and exposure time to sunlight. It is recommended for future studies to take into account these factors in designing the future studies that include the Malay population in clinical and research.

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