EFFECTS ON VISUAL EVOKED POTENTIAL IN MYOPIA

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Background and Objectives: Myopia is a highly significant problem because it can increase the risk for vision-threatening conditions. As visual cortex is activated primarily by the central visual field, VEPs depend on functional integrity of central vision at all levels of the visual pathway. Objective of this study is to find effect of myopia on VEP by using Flash VEP and compare it with previous studies.

Methods: This is a retrospective study of patients who were clinically diagnosed with myopia and advised extended testing which included electrophysiological studies such as VEP. The patients were sent to us by M & J Western Regional Institute of Ophthalmology, Ahmedabad. All the data was recorded in the Microsoft Excel Spreadsheet. Analysis was done using SPSS version 22**.** p value <0.05 was considered statistically significant. Unpaired t-test was used to compare the distribution of variables across the three degrees of myopia viz. mild, moderate and severe.**Results**: The mean ± SD for latency of P100 in mild, moderate and severe myopia was 99.0±5.5 ms, 97.6±3.63 ms, 108.2 ±4.71ms and 104.0±2.0 ms, 101.22±3.04 ms, 118.45± 4.99 ms for right eye and left eye respectively. The increase in latency of P100 was particularly significant on comparison of moderate and mild degree myopics with those having severe degree (p<0.0001), (p<0.0231) and (p<0.0.0001), (p<0.0062) for right and left eye respectively.High degree of myopia is also associated with significant reduction in the amplitude in many of the cases.

Interpretation and Conclusion: There is prolongation of latency in myopic patients and latency significantly changes with higher degree of myopia. Along with latency, there is also a decrease in the amplitude with presence of high degree of myopia. Thus, latency and amplitude are negatively correlated

Keywords: *Flash VEP, latency, amplitude, myopia*

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INTRODUCTION

VISUAL EVOKED POTENTIALS **(VEPs)** reflect electrical phenomena occurring during the visual processing and are a graphic illustration of the cerebral electrical potentials generated by the occipital cortex evoked by a defined visual stimulus[1]. Evoked electrophysiological signals extracted from the electroencephalographic activity in the visual cortex recorded from the overlying scalp electrode.

As visual cortex is activated primarily by the central visual field, VEPs depend on functional integrity of central vision at all levels of the visual pathway including the eye, retina, the optic nerve, optic radiations and the occipital cortex.[2]

VEP waveforms are represented on graphs using amplitude and time (latency) measurements. In general terms, the amplitude, measured in microvolt's (µv), indicates the integrity of the neural structures including axons conducting information along the visual pathway. Latency, measured in milliseconds (ms), indicates the time the electrical signal takes to travel from the retina to the visual cortex. The combination of amplitude and latency is helpful in determining the health of the visual pathway.

A normal VEP is generally associated with normal visual examination however an abnormal VEP study may or may not be associated with normal clinical findings. Various variables can affect recording of VEP like refractive errors, age, sex hormones, eye dominance & illumination. It has been established by various studies that P100 wave latency is one of the major discriminator between normality and abnormality of visual pathway[3].

METHODS & MODALITIES OF VEPs

MAINLY TWO KINDS OF VISUAL STIMULI ARE USED TO GENERATE VEPs[4]:

(1) UNPATTERNED FLASHING LIGHTS: Brief flashes of light with no perceptible pattern or contour comprise the un-patterned stimulus. Such simple un-patterned VEPs are of use when pattern stimulation is rendered inappropriate in cases of poor optical media, lack of cooperation, or diminished vision.

(2) PATTERNED STIMULI: The recommended patterned stimulus is a checkerboard with black

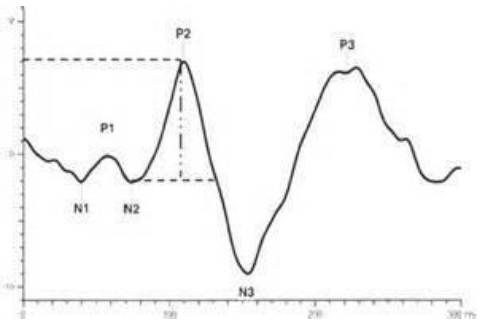
and white pattern. All the checks have to be square making an equal number of light and dark ones. Patterned stimuli are defined by a visual angle subtended by the side of a single check in degrees (°) or minutes of arc (min) subtended at the eye. One degree equals 60 min of arc. The size of the individual checks usually reported in terms of visual angle in minutes of arc. Pattern stimuli can be presented in three ways:

(a)FLASH VEPs

(b) PATTERN ONSET/OFFSET VEPs

(c)PATTERN REVERSAL VEPs (PRVEPs)

FLASH VEPs can be generated by a pattern of flashing luminance spanning visual field of about 20degrees. The flash



rate has to be kept as 1.0Hz ± 10% that is about 1flash/sec. The flash VEP waveform consists of a succession of negative and positive waves. The first distinguishable wave appears 30ms after the stimulus and the latter components are obtained up till 300ms. Peaks are consequently labelled in a numerical series as negative and positive. Such a nomenclature enables differentiation of flash VEP from the pattern reversal type. Mainly the significant components of the flash VEP evident are the N2 and P2 peaks. P2 amplitude is to be measured from the P2 peak at approximately 120ms to the former N2 negative peak at about 90ms. Flash VEP is of particular use for patients who are incapable or show reluctance for pattern VEPs and when pattern stimuli seem in valid due to the presence of opacities in media.

VEP may be affected by variety of physiological factors including age, sex, visual acuity and pupillary size. It may also be affected by measures related to technique including check size, luminance, field size, etc[5]. Gender has been recognized as an important physiological factor which can affect both the amplitude and latency of pattern reversal VEP parameters. Many previous studies throughout the age span have found both larger P100 amplitudes and shorter P100 latencies in females[6].

Myopia or Short-Sightedness is a type of refractive error in which parallel rays of light coming from infinity are focused in front of the retina when accommodation is at rest.

Myopia can be classified into three broad groups based on clinical findings and prognosis[7].

- The first type is **PHYSIOLOGICAL, OR CORRELATION, MYOPIA**. In these eyes all the components of refraction are within normal limits, but there is a lack of correlation between the refractive powers of the cornea, lens and axial length rendering the far point nearer than infinity. Although decreased distance vision results, these eyes are otherwise normal and there are no fundus abnormalities.
- The second type is **INTERMEDIATE MYOPIA**. This form of myopia appears to be very similar to physiological myopia, although the age of onset may be slightly younger and the final amount of myopia tends to be higher. The main difference is that in these eyes the components of refraction do not fall all of within the normal range; The axial length is notably longer. Over time, fundus changes appear, often beginning in childhood.
- The third major type, and the most devastating, is **PATHOLOGICAL MYOPIA**. In this form, a highly myopic refractive error is often present from early childhood and is usually progressive. Increased axial length and fundus changes are evident at the earliest examination. Prognosis is poor, with legal blindness resulting from maculopathy or retinal detachment in almost 50% of eyes

On the basis of degree of myopia, it has been classified into 3 categories:[8]

- Mild myopia (<3.00D)
- Moderate myopia (3.00D- 6.00D)
- Severe myopia (>6.00D)

The objectives of our study are:

To study the effect of Myopia on Flash VEP finding.

To study visual evoked potential in different grades of myopia.

To check for correlation between Axial length and the latencies in VEP

MATERIALS AND METHODS

This is a retrospective study of patients who were clinically diagnosed with myopia and advised extended testing which included electrophysiological studies such as VEP. The patients were sent to us by M & J Western Regional Institute of Ophthalmology, Ahmedabad.
Exclusion criteria for selection of the candidates were H/O Eye Surgery, Color-Blindness, H/O Hypertension, Diabetes Mellitus, Thyroid, H/O Seizures and those on anti-depressants. 31 candidates were included in the study after applying the above exclusion criteria.
Device used for recording of VEP was the standard flash presented by positioning an integrating Ganzfeld bowl. Daily 2-3 candidates were called for recording between 10AM to 1PM. All patients were instructed for –

- Washing of hair to make hair oil free and not to apply oil or any type of lotion before test.
- To take good sleep and normal meal.
- To remove contact lenses during procedure.
- No eye drops instillation prior to testing.

Technical setting for recording of VEP used was Channels –

- Active – Mid-Occiput - Oz.
- Reference – Mid Frontal - Fz.
- Ground – On hair line of forehead-Cz
- Low Filter = 48Hz cut of frequency
- High Filter = 12Hz cut of frequency

Rate of stimulation was 1½ Flash/sec. After fulfilling exclusion criteria and history and examination for visual acuity for confirmation of refractive error along with written consent candidate was asked to sit on a comfortable chair facing in opposite direction from the recording monitor. Candidate was well informed about the procedure. Electrodes were placed with the conductive paste over the positions mentioned above after cleaning the area beforehand. Stimulation was given to eyes one after another at above mentioned rate and epochs.
All the data was recorded in the Microsoft Excel Spreadsheet. Analysis was done using SPSS version 22**.** p value <0.05 was considered statistically significant. Unpaired t-test was used to compare the distribution of variables across the three degrees of myopia viz. mild, moderate and severe.

RESULTS

In our study we have done VEP of 31 Subjects having myopia. Out of them 18 are males and 13 are females. Majority of the patients were between 11-30 years of age (63.92%).

Table 1: Axial length of Both Eye in Male and Female

No	Axial Length in mm	Right Eye			Left Eye			Grand Total
		M	F	Total	M	F	Total	
1	20-25 mm	9	11	20	10	11	21	41
2	26-30 mm	8	1	9	7	1	8	17
3	31-35 mm	1	1	2	1	1	2	04

Table 2: Degree of Myopia and Axial Length in Both Eye.

Degree of Myopia	Right Eye Axial Length in mm				Left Eye Axial Length in mm				Grand Total (R+L)
	20-25	26-30	31-35	Total (R)	20-25	26-30	31-35	Total (L)	
Mild	02	00	00	02	02	00	00	02	03
Moderate	14	01	00	15	17	01	00	18	33
Severe	04	08	02	14	02	07	02	11	26
Total	20	09	02	31	21	08	02	31	62

Comparisons between various degrees of myopia
RIGHT EYE

Table 3(a): Latency and Amplitude in Mild v/s Moderate myopia

	Mild myopia	Moderate Myopia	p-value
Latency(ms)			
N75	62.0±4.26	72.61±4.78	**0.0096**
P100	99.0±5.5	97.6±3.63	0.6302
Amplitude(μV)			
N75	3.51±0.25	3.42± 1.93	0.9498
P100	3.73±0.75	4.23± 1.74	0.7002
N	2	15	

Table 3(b): Latency and Amplitude in Moderate v/s Severe myopia

	Moderate Myopia	Severe Myopia	p-value
Latency(ms)			
N75	72.61±4.78	84.87 ±5.91	**0.0001**
P100	97.6±3.63	108.2 ±4.71	**0.0001**
Amplitude(μV)			
N75	3.42± 1.93	2.13± 1.36	**0.0485**
P100	4.23± 1.74	3.3± 1.43	0.1290
N	15	14	

Table 3(c): Latency and Amplitude in Mild v/s Severe myopia

	Mild myopia	Severe Myopia	p-value
Latency(ms)			
N75	62.0±4.26	84.87 ±5.91	**0.0001**
P100	99.0±5.5	108.2 ±4.71	**0.0231**
Amplitude(μV)			
N75	3.51±0.25	2.13± 1.36	0.1859
P100	3.73±0.75	3.3± 1.43	0.4300
N	2	14	

LEFT EYE

Table 4(a): Latency and Amplitude in Mild v/s Moderate myopia

	Mild myopia	Moderate Myopia	p-value
Latency(ms)			
N75	73.5±3.5	77.11±4.13	0.2526
P100	104.0±2.0	101.22±3.04	0.2285
Amplitude(μV)			
N75	3.63± 1.98	3.43± 1.73	0.8795
P100	4.0± 2.3	4.11± 1.86	0.2807
N	2	18	

Table 4(b): Latency and Amplitude in Moderate v/s Severe myopia

	Moderate Myopia	Severe Myopia	p-value
Latency(ms)			
N75	77.11±4.13	94.18 ±6.76	**0.0001**
P100	101.22±3.04	118.45± 4.99	**0.0001**
Amplitude(μV)			
N75	3.43± 1.73	2.17± 1.67	0.0645
P100	4.11± 1.86	2.43± 1.65	**0.0206**
N	18	11	

Table 4(c): Latency and Amplitude in Mild v/s Severe myopia

	Mild myopia	Severe Myopia	p-value

Latency(ms)			
N75	73.5±3.5	94.18 ±6.76	**0.0017**
P100	106.0±2.0	118.45± 4.99	**0.0062**
Amplitude(μV)			
N75	3.63± 1.98	2.17± 1.67	0.2878
P100	4.0± 2.3	2.43± 1.65	0.2599
N	2	11	

Interpretation: From the above findings, it is clear that higher degrees of myopia are associated with a significant increase in the latency period. It is also associated with reduction in the amplitude in many of the cases. Thus, latency is positively correlated whereas, amplitude is negatively correlated.

Table 5: Axial Length and Latency in Right Eye

Axial Length in mm	Latency in right eye(in ms)	
	N75	P100
20-25 mm	75.9±8.19	102.75±6.52
26-30mm	84.0±7.31	106.44±5.89
31-35mm	95.0±4.23	116.5±4.5

Table 6: Axial Length and Latency in Left Eye

Axial Length in mm	Latency in left eye(in ms)	
	N75	P100
20-25mm	77.24±6.83	101.1±4.21
26-30mm	88.63±7.86	118.5±7.07
31-35mm	105.0±5.12	138.0±6.0

From table (5) and (6) we find that as the axial length of the eyeball increases, the latency period also increases. This is supported by the fact that increase in axial length is directly proportionate to the degree of myopia.[9]

DISCUSSION

In our study we enrolled 31 subjects (18 males and 13 females) to study the effects of visual evoked response (VEP) in myopia. Whereas, study conducted by Lee et al[10] and Anju et al[13] comprised of 28 and 61 subjects respectively.

In the study conducted by Anju et al[11,] the mean value of latency of P100 for subjects with refractive error was 85.851ms for right eye and for left eye 94.461 ms and p-Value equals 0.0047 which is very statistically significant. Unpaired student t-test for latency of P100 of group without refractive error and with refractive error was highly significant as p-Value equals 0.0079.

As many of physical parameters affect the result of VEP, one of them is refractive error, so it is necessary on part of any clinical neurophysiological examination refractive error should be kept in mind to obtain reasonable accurate and reliable data and to minimize false-positives.[13]

A study by Kothari et al[14] has also shown that there is no statistical significant difference in latency of P100 between both eyes in group without refractive error but in group with refractive error it is statistically highly significant.

In the study conducted by Lee et al[10], subjects were divided into three groups (mild, moderate, severe myopia) according to refraction and they evaluated the results of VEP studies. The Mean values of refraction and latency (P100) of naked eyes were -4.27 DS, 103.95 ms and those of corrected eyes (in glasses) were -0.25 DS, 100.59 ms. Respectively, in mild, moderate, and severe myopia, the P100 latency of naked eyes were 101.27 ms, 102.59 ms, 107.99 ms and those of corrected eyes were 98.33 ms, 100.58 ms, 102.19 ms respectively ($P < 0.05$). There was significant negative correlation between refraction and P100 latency in myopia.

This correlation is similar to that established in our study. In our study also, we find that higher degrees of myopia are associated with a significant increase in the latency period. The mean ± SD for latency of P100 in mild, moderate and severe myopia was 99.0±5.5 ms, 97.6±3.63 ms, 108.2 ±4.71ms and 104.0±2.0 ms, 101.22±3.04 ms, 118.45± 4.99 ms for right eye and left eye respectively. The increase in latency of P100 was particularly significant on comparison of moderate and mild degree myopics with those having severe degree (p<0.0001), (p<0.0231) and (p<0.0.0001), (p<0.0062) for right and left eye

respectively.

It is also associated with reduction in the amplitude in many of the cases. Thus, latency is positively correlated whereas, amplitude is negatively correlated with severity of myopia.

Even a study done by Aashish et al[12] showed a strong negative correlation with P100 amplitude and strong positive correlation with P100 latency.

CONCLUSION

Our study shows that there is prolongation of latency in myopic patients and latency significantly changes with higher degree of myopia. Along with latency, there is also a decrease in the amplitude with presence of high degree of myopia. Thus, latency and amplitude are negatively correlated.

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