

## Does gender influence visual evoked potentials?

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### Abstract

**Background and Aim:** Visual evoked potential (VEP) is a useful noninvasive neurodiagnostic tool which permits assessment of functional integrity of visual pathways. It is affected by certain physical and physiological parameters. To date, only few baseline studies have been carried out in India assessing the effect of gender on VEP.

Therefore, the present study was conducted to evaluate the effect of gender on VEP.

**Materials & Methods:** 30 healthy subjects of either sex within the age group 18-40yrs were recruited and divided into male and female group with 15 subjects in each group. Monocular pattern reversal visual evoked potentials (PRVEP) were recorded using standard protocol. Latencies and amplitude of various waveforms were calculated and studied.

**Results:** Our study revealed longer latencies of all the waves in male group than the female group in line with other such studies; however the difference was not statistically significant (p value > 0.05). Statistically insignificant difference in amplitude of P100-N75 and inter-ocular difference in P100 latency was also observed.

**Conclusion:** The present study disproved the influence of gender on VEP. However, more studies with bigger sample size are advocated.

**Keywords:** latencies, neurodiagnostic, pattern reversal visual evoked potentials, visual evoked potential.

### 1. Introduction

Evoked Potentials (EP) today form an important part of electrophysiological armamentarium. These are ancillary neurodiagnostic tools which permit conduction velocity assessment of sensory impulses in central and peripheral nervous system.[1,2] Evoked Potentials (EP) have the advantages of being objective and often more sensitive than detailed neurological examination.[3] These may be useful when EEG is useless and may diagnose subclinical conditions.[4]

Visual evoked potentials (VEP) are electrical potential differences recorded from scalp overlying visual cortex in response to visual stimuli. VEP is primarily a reflection of activity originating in the central 3-6° of visual field.[5] Visual evoked potentials (VEP) offer reproducible and quantitative data on the function of visual pathways and visual cortex.[6] VEP better quantify functional integrity of the optic pathways than scanning techniques such as magnetic resonance imaging (MRI).[7]

Visual evoked potentials (VEP) are affected by certain physical factors (pattern size, pattern contrast, mean luminance etc.) and certain physiological factors (age, sex, head circumference etc.).[8-12] To date, few studies have been done in India evaluating the effect of gender on VEP. Therefore, in our study, we tried to evaluate the effect of

gender on VEP parameters. Pattern reversal visual evoked potentials (PRVEP) were recorded in our study as these are less variable in timing and waveform.

### 2. Materials and Methods

The present study was conducted in 30 healthy subjects (15 males, 15 females) within the age group 18-40 years at the Electrophysiology lab in the department of Physiology, Pt. B.D. Sharma PGIMS, Rohtak. Ethical clearance from the institutional ethics committee was taken and informed written consent from the volunteers was also obtained before starting the study.

#### 2.1 Inclusion criteria:

Healthy subjects of either sex in the age group 18-40yrs willing for the test.

#### 2.2 Exclusion criteria:

- Presence of any illness that could influence visual evoked potentials
- Best corrected visual acuity worse than 6/60
- Extreme pupil sizes
- History of major illness like diabetes, hypertension

Recording of PRVEP was done on RMS EMG EP MK2 machine using the following settings:

**Stimulation:**

- Black and white checkerboard
- Contrast – 70%
- Full field size > 8°
- Size of pattern – 8x8 min
- Rate of stimuli – 1.5Hz
- Mean luminance of the central field – 50cd/m<sup>2</sup>
- Background luminance – 30cd/m<sup>2</sup>

**Recording conditions:**

- Low filter - 2Hz
- High filter - 100Hz
- Sweep duration -300ms
- Number of epochs - 100
- Sweep speed - 50ms/division
- Sensitivity - 2microvolt/division

The volume conducted evoked responses were picked up from scalp by using disc type of Ag/AgCl electrodes placed as per 10-20 international system of placement. An active electrode was placed on the scalp over the visual cortex (O<sub>z</sub>) with ground electrode on the forehead (F<sub>z</sub>). Two reference electrodes were attached to right and left mastoid designated as O<sub>1</sub> and O<sub>2</sub> respectively. All the electrodes were plugged to a junction box. Skin to electrode impedance was monitored and kept below 5Kohms. Two channel recording was done using the following montage:[13]  
Channel 1: O<sub>z</sub>- O<sub>1</sub>  
Channel 2: O<sub>z</sub>- O<sub>2</sub>  
Ground electrode: F<sub>z</sub>

**2.4 Procedure:**

Subjects were explained all about the procedure and their informed written consent was obtained. Subjects were asked to sit on a table in relaxed position about 100 cm from the monitor. The visual stimuli consisting of black and white checks generated by a TV system reversing at the rate of 1.5 Hz was presented to one eye with other eye being covered. Subjects were instructed to focus on a rectangle displayed at the centre of the screen. Total 100 stimulations were presented monocularly. The signals were picked up by the electrodes and filtered, amplified, averaged, displayed on the screen of RMS EMG EP MK2 and recorded.

The normal recording of PRVEP consisted of 3 waves: N75, P100 and N145. Latencies of waves N75, P100 and N145 and amplitude of P100 from the preceding N75 peak was measured from the recordings and data were entered in the subject's proforma.

**2.5 Statistical analysis:**

The mean and standard deviation for latencies and amplitude of VEP waves was calculated. The data was analyzed statistically using student t-test to compare the results between two group and p-values were obtained. The statistical analysis was carried out using SPSS PC software version 13.0.

P value > 0.05 was considered as not significant.

P value < 0.05 was considered as significant.

P value < 0.01 was considered as highly significant.

**3. Observations and Results**

The present study tested VEP latencies and amplitude in age matched healthy subjects divided into male and female groups with each group having 15 subjects.

The average age of male and female group was quite similar. The average height and weight of male subjects was significantly higher as compared to female subjects but BMI (Body Mass Index) differed only slightly between the two groups and that too was statistically insignificant (Table 1).

**Table 1: Physical parameters of Male (N=15) and Female (N=15) group**

Data	Males (Mean ± SD)	Females (Mean ± SD)	P Value
Age (Yrs)	27.33 ± 8.04	27.27 ± 8.46	0.98
Height (cm)	169.40 ± 4.36	155.60 ± 7.04	< 0.01**
Weight (Kg)	63.67 ± 9.63	53.20 ± 8.60	< 0.05*
BMI (Kg/m <sup>2</sup> )	22.13 ± 2.77	21.95 ± 3.04	0.86

\* Statistically significant, \*\* statistically highly significant

Latencies of all the waves of PRVEP were found to be longer in male group as compared to female group both in right eye as well as the left eye. However, the difference was not statistically significant (p value > 0.05). A statistically insignificant slight difference in amplitude of P100-N75 (higher in females) was also observed in both the eyes for two groups (Table 2, Table 3).

**Table 2: Comparison of Latencies and Amplitude of PRVEP waveforms in Right Eye b/w Male and Female group**

Wave	Males (Mean ± SD)	Females (Mean ± SD)	P Value
N75 (ms)	69.00 ± 5.91	67.23 ± 4.62	0.46
P100 (ms)	103.85 ± 7.62	100.21 ± 6.58	0.19
N145 (ms)	151.04 ± 16.31	143.86 ± 15.64	0.22
P100-N75 (µV)	3.54 ± 2.36	3.56 ± 1.73	0.99

**Table 3: Comparison of Latencies and Amplitude of PRVEP waveforms in Left Eye b/w Male and Female group**

Wave	Males (Mean ± SD)	Females (Mean ± SD)	P Value
N75 (ms)	68.32 ± 5.83	66.50 ± 4.44	0.43
P100 (ms)	102.75 ± 6.95	99.60 ± 5.83	0.26
N145 (ms)	148.97 ± 15.30	147.55 ± 14.31	0.80
P100-N75 (µV)	4.15 ± 2.42	4.18 ± 1.77	0.67

Inter-ocular difference in P100 Latency was also found to be longer in male group; however the difference was statistically insignificant (Table 4).

**Table 4: Comparison of Inter-ocular difference in P100 Latency b/w Male and Female group**

	Males (Mean±SD)	Females (Mean ± SD)	P Value
Inter-ocular difference	4.25 ± 4.96	1.91 ± 1.56	0.12

**4. Discussion**

Visual evoked response testing has been one of the most exciting clinical tools to be developed from neurophysiologic research in recent years and has provided us with an objective method of identifying abnormalities of visual pathways.[6] However, standardization of recording parameters is must for its optimum use and validity.[14] Age

being a proven factor affecting VEP;[10,12] in the present study focus was to highlight the effect of gender.

The present study revealed shorter latencies and higher amplitude of PRVEP waves in females than males; however the difference was not statistically significant. The results of our study are in agreement with other such studies which also reported no significant gender difference in VEP parameters.[15,16] On the contrary, some studies reported significant difference in VEP parameters between two sexes.[11,17,18] Gregori et al investigated the influence of gender and head size on VEP latencies. He found out that P100 latency was slightly shorter in females than males and this small difference reached weak statistical significance ( $p < 0.05$ ) whereas head size differed significantly ( $p < 0.001$ ) between sexes (females < males). No difference was found in the P100 latency in the subgroup of the two sexes with a comparable range of head size. He concluded that the slight sex difference observed in P100 latency was mainly because of slightly smaller average head size in females than in males and head size, not sex, should be considered for VEP latency normative studies.[19] Recently, Dion et al analyzed the sex differences in VEP parameters in school-age children. They observed shorter latencies in girls appeared mostly due to head size.[20]

The difference in VEP latencies between two genders can also be attributed to factors like shorter axial eye length in females as compared to males;[21] early cerebral maturation in female children as evidenced by increased alpha frequency and greater photo sensitivity in females than males;[22] comparatively smaller brain size in females;[23] 2-5 ms faster reaction time in females than males[24] or because of some hormonal factors.[10]

Statistically insignificant inter-ocular difference in P100 latency that was observed between two sexes can be due to either lateralization of central nervous system or neuroanatomical asymmetry.[25,26] Presence of significant inter eye difference rather becomes a proof of some monocular disease.[27]

## 5. Conclusion

The findings of our study suggest that VEP parameters are not affected by sex. Thus, gender should not be considered for VEP normative values. It is advised that further studies be done with bigger sample size, taking care of all the confounding factors to conclusively establish the effect of gender on VEP and also to find out the underlying mechanism for the observed difference, if any.

## Limitations of the study

- Major limitation of the present study was the small sample size.
- Head size, proven variable affecting VEP in many studies, was not considered in the present study.

- PRVEP been a subjective test, thus test results are dependent on the degree of cooperation and attention of the subjects during recording.

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**Conflict of interest:**

Authors declare they have no conflict of interest

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