

Original article

Flash Visual Evoked Potential Recording in Patients with Orbital Fracture

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Abstract

Aim: Orbital fractures are complex facial fractures that require careful treatment to prevent visual complications. One suitable technique for assessing visual pathway disturbances in these patients is visual evoked potential. This study aims to record and analyze visual evoked potentials in patients with orbital fractures in order to improve understanding and treatment of this condition.

Materials and Methods: Twenty patients with severe orbital fractures and resulting visual impairment in eleven eyes were referred to Basir Eye Clinic for treatment. The patients, mostly males, were between the ages of 15 and 35. In order to assess their visual function, visual evoked potentials (VEP) were recorded using flash stimulation. The latency (in milliseconds) and amplitude (in microvolts) of the P100 component of the VEP were measured in the patient group and compared to a control group of 11 individuals matched for age and sex who had a healthy visual system.

Results: The mean age of inpatient and healthy groups was respectively 24.25 ± 6.52 and 24.25 ± 6.56 . The study included two groups with an equal number of males and females. There, no statistically significant difference in terms of age and sex between the two groups. The best corrected visual acuity (BCVA) showed a large difference between the two groups, with the patients having only light perception ability while the control group had full vision (10/10). The mean latency for VEP100 peak was 130.36 ± 8 in the case group and 99.63 ± 2.33 in the control group. The mean amplitude was 1.27 ± 0.46 in the case group and 4.27 ± 0.78 in the control group. Both the latency and amplitude of VEP100 peak showed significant differences between the case and control groups ($P < 0.001$).

Conclusion: Head trauma can result in eye dysfunction, primarily affecting the visual pathway. One way to diagnose this condition is by measuring the latency and amplitude of the VEP p1000 peak.

Keywords: Orbital Fracture; Visual Disturbances; Flash Visual Evoked Potential.

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Introduction

Orbital fractures are a result of one or more bones surrounding the eyeball breaking. These fractures typically occur after an injury or a blow to the face. As a result, various consequences can arise, such as a decrease in visual acuity, depending on the severity of the injury. Many diagnostic techniques, such as visual electrophysiology, are used to screen patients based on visual damage. It is a fact that electrophysiological techniques i.e. Other methods include electrooculography (EOG), electroretinography (ERG), and visual evoked potential (VEP).

Abdolzadeh et al. (2023) researched the visual system, specifically the retina, of patients undergoing treatment with anti-epileptic medication. They found that these drugs may have an impact on a specific retinal layer called the retinal pigment epithelium (RPE). The diagnosis of this condition can be determined through the Arden Index (AI) of the Electrooculogram (EOG) test¹. Sarzaeim F. et al. (2022) investigated the effect of hand-arm vibration on the retina of road drilling machine laborers, as measured by ERG (Electroretinography). Their findings suggest that occupational vibration produced by these machinery may have adverse effects on the human retina, which can be diagnosed by analyzing the amplitude of the ERG b-wave². Ameli S. (2023) found that stroke can cause damage to the visual system mainly the visual pathway which can be measured by VEP parameters mainly latency of VEP P100 peak³. Other studies⁴⁻³⁷ prove the usefulness of these techniques in different pathological conditions of the visual system. Sarzamin F. et al. (2022) examined visual pathway disturbances in patients who experienced head trauma using VEP. They utilized flash stimulation in these patients and observed a delay in the latency

of VEP, specifically the P100 peak. This delay demonstrated the impact of head trauma on the visual system, particularly the visual pathway³⁸.

Patients and methods

In this investigation, 20 patients between 15 and 35 years, including 18 males and 2 females who experienced orbital fractures and significant visual impairment in the affected eye were chosen for the case group. The best-corrected visual acuity (BCVA) in the 11 affected eyes was identified as light perception (LP). Visual Evoked Potentials (VEP) using flash stimulation were utilized to evaluate the visual pathway of these patients. Specifically, the latency (measured in milliseconds) and amplitude (measured in microvolts) of the P100 peak in the VEP were recorded for all patients using a Mangoni machine. Electrodes were affixed to the patients to connect them to the machine, with active, reference and ground electrodes situated on the occipital, vertex, and forehead regions, respectively.

A parallel procedure was conducted with a control group consisting of 20 healthy individuals matched in terms of age and sex, in order to analyze and compare the obtained results. The obtained results from both groups were then compared to identify potential disparities between the groups.

Results

Table 1 shows demographic information of the subjects in the case and control groups. As shown, there was no statistical difference between the two groups regarding age ($p=0.001$) and sex.

Regarding visual acuity, there was a significant difference between the case and control groups. The case group demonstrated light perception ability, while the control group exhibited

Table 1: Demographic information of subjects in the case and control groups

Variable	Number of participants	groups (Mean $\pm$ SD)		P value
		Control	Case	
Age	20	24.25 $\pm$ 6.56	24.25 $\pm$ 6.52	1 *
Sex	Mail	18 (90 %)	18 (90 %)	1 **
	Femail	2 (10 %)	2 (10 %)	

* Based on T Test

** Based on Chi-Square Tests

Table 2: The measured mean latency and amplitude of the VEP P100 peak in case and control groups

Variable	Number of participants	groups (Mean $\pm$ SD)		P value*
		Control	Case	
Latency (msec)	11	99.63 $\pm$ 2.33	130.36 $\pm$ 8	0
Amplitude (μ v)	11	4.27 $\pm$ 0.78	1.27 $\pm$ 0.46	0

* Based on the Mann-Whitney U Test

complete visual acuity.

Table 2 presents the measured mean latency and amplitude of VEP, P100 peak in both the case and control groups. The table indicates a statistically significant difference in the VEP P100 peak in terms of latency ($P = 0.001$) and amplitude ($P = 0.001$) between the two groups.

Discussion

Orbital fracture is a severe injury that can result in visual impairment or even blindness. To screen and monitor this condition, the VEP technique is considered suitable. In two relevant studies on injured eyes caused by orbital fracture, the VEP recording technique revealed an increase in implicit time and a decrease in the amplitude of the VEP P100 peak. This technique is widely recognized as an indicator of visual pathway performance ^{39, 40},

suggesting that any form of pathological alterations in VEP parameters can serve as evidence of visual pathway involvement in patients. The references provided in this document may further support the findings of the current study.

Tian Y. et al. (2021) developed a sensitive diagnostic tool to study traumatic optic neuropathy and analyze 137 eyes from 131 patients. The subjects were diagnosed with orbital fractures between 2016 and 2019. The researchers found that the sensitivity of Visual Evoked Potential (VEP) was a significant factor in this study⁴¹, indicating the potential application of this technique. It is worth mentioning that the flash type of VEP is particularly useful for assessing visual pathway function in these patients ⁴².

Liu S. et al. (2018) evaluated visual function

in patients with orbital fractures. They utilized various diagnostic techniques, including flash VEP. They found pathological changes in the VEP P100 peak, specifically in terms of latency and amplitude. These findings support the results of the present study^{43, 44}.

Conclusion

The comprehensive evaluation of VEP parameters, especially the flash VEP, stands as a significant aid in assessing the status of the visual pathway in individuals affected by orbital fractures. Such assessments provide valuable insights that can guide clinical decision-making and improve patient management, aiming to prevent visual impairment or blindness arising from these severe injuries. Overall, the flash VEP technique, focusing on P100 peak parameters, represents a promising avenue for diagnosing and monitoring visual pathway involvement in patients with orbital fractures.

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Footnotes and Financial Disclosures

Conflict of interest:

The authors have no conflict of interest with the subject matter of the present manuscript.