

# Visual evoked potential and optical coherence tomography in pseudotumor cerebri

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## Abstract

**Aim:** To evaluate pattern visual evoked potential(pVEP) and retinal nerve fiber layer thickness(RNFL) of the patients who were diagnosed as pseudotumor cerebri(PTC) at the stage of diagnosis and after the papilledema improvement. **Methods:** Twenty eyes of 10 patients who had been diagnosed with PTC were included in the study. All patients were tested by pVEP and optical coherence tomography (OCT) for RNLF in the stage of the diagnosis and after papilledema improvement. Data belonging to two separate periods were compared statistically. Student's t test and Mann-Whitney U test was used for statistical evaluation. P values <0.05 were considered to be statistically significant. **Results:** Median average latency time of the first pVEP test was  $135.5 \pm 13.5$ ms, while  $131.5 \pm 12.2$ ms were measured after the papilledema improvement. With shorter latency period detected in the recovery period, the difference was not statistically significant ( $p > 0.05$ ). The diagnostic phase and recovery period, the median average RNFL measurements were determined as  $91.35 \pm 16.1 \mu$  and  $131.8 \pm 93.2 \mu$ . The difference between the two measurements was statistically significant ( $p < 0.05$ ). **Conclusions:** Papilledema initially does not disrupt the function of the optic nerve and retinal nerve fiber layer, but it may lead to an elongation of the p100 latency in pVEP test and an increase in RNFL. After elimination of the effect of edema, changes in the optic nerve and RNFL improve. When papilledema is not treated and becomes chronic, ischemic symptoms may occur with the effect of pressure on the nerve fibers and retinal nerve fiber layer. Therefore, early diagnosis and treatment are extremely important.

## Introduction

The optic disc swelling, which occurs due to the increased intracranial pressure, described as papilledema. Pseudotumor cerebri (PTC) is a syndrome of increased intracranial pressure without hydrocephalus or mass lesion and with normal cerebrospinal fluid (CSF) composition. PTC is characterized by headache and optic disc edema in classical. Temporary vision loss and double vision may be seen. Neurological symptoms are not observed outside the 6th nerve palsy. It usually occurs in young and middle aged women and often etiology is unknown [1-5].

In order to rule out a possible neurological emergency, patients who have papilledema are evaluated by imaging techniques such as computed tomography (CT) and / or MRI for detailed evaluation of intracranial structures. Optic disc swelling occurs due to many reasons such as ischemic optic neuropathy, optic neuritis and central retinal vein occlusion. It is important to distinguish the pseudo-papilledema from the condition causing acute optic disc swelling [1-5].

Electrophysiological tests evaluate the visual system from the retinal pigment epithelium (RPE) to the occipital cortex. Pattern VEP test shows the response of the cortical cells against a pattern stimuli [6-11].

OCT is based on low-coherence interferometers. OCT gives high-resolution cross-sectional images by detecting

the reflection delay time and violence of the infrared light waves which was transmitted to the tissue and reflected back from different tissue layers. In this sense, it provides optical tissue biopsy to the clinician. RNFL can be evaluated according to the difference between the optical reflectivity of the retina [12-15]. The reliability and reproducibility of RNLF measurements by OCT has been shown in several studies which evaluate normal eyes, glaucomatous eyes and optic neuritis. In the literature, the importance of total retinal thickness measurement and RNLF are often emphasized in the diagnosis, differential diagnosis and follow-up of optic disc swelling [15-18].

## METHODS

Twenty eyes of 10 patients who had been diagnosed with PTC were included in the study. Patients were informed about the optic disc swelling, prognosis of the disease and the tests, patients consent forms were included. Study was organized according to the Declaration of Helsinki and ethics committee approval was received.

PTC was diagnosed according to Dandy criteria:1-4 1. Symptoms and signs that may be associated with a high intracranial pressure (headache, papilledema, etc.); 2. Documented increased CSF opening pressure higher than 25 cm H<sub>2</sub>O, with normal CSF composition; 3. No abnormal neurological findings except a sixth nerve palsy; 4. Absence of any space occupying lesions on neuroradiological imaging [1-4].

Complete ophthalmologic examination was performed and the patients were questioned in terms of systemic disease. According to International Society for Clinical Electrophysiology of Vision (ISCEV) standards, the patients were tested by Metrovision brand monpack model visual electrophysiology device for pattern VEP tests [6, 10, 11] and RNFL was analyzed by Stratus OCT (Zeiss Stratus OCT Model 3000 device). After the patients were evaluated together with neurology clinic, acetazolamide treatment was started according to papilledema and CSF pressure. The patients were followed for six months and at the end of six months papilledema improved patients were included in the study. After papilledema improvement, RNFL and pVEP values were recorded and analyzed again. The results were compared statistically. Student's t test and Mann-Whitney U test was used for statistical evaluation. Statistical significance of  $p < 0.05$  were considered.

Diagnostic test (median)	Diagnosis stage	Improvement stage	p
pVEP (ms)	135,5 ± 13,5	131,5 ± 12,2	0,15
OCT (RNLF) μ	131,8 ± 93,2	91,35 ± 16,1	0.02

**Table 1.** The comparison of p VEP and RNLF values in the diagnosis and improvement stage.

## Results

All of the patients were female. The mean age was 19 and 55 years ( mean 33.5 ± 15.6). VEP testing done at the diagnosis of the patients, according to ISCEV standard, 120, 60, and 30,15,7 'patterns were shown. The visual acuity of all patients was recorded 1.0 by the Snellen chart. In the evaluation of seven minutes (minimum)

pattern latency and amplitude values were within normal ranges during the acute phase and recovery period. In the recovery period, shortening of the latency value was determined. The median average of latency time in pVEP test was 135 ± 13.5 ms at the diagnostic phase, whereas it was measured 131.5 ± 12.2 ms after papillary edema improvement. Although there is some decrease in the latency period, this difference was not statistically significant ( $p > 0.05$ ).

The median average of RNFL measurement was 131.8 ± 93.2 μ at the diagnostic phase, whereas it was measured 91.35 ± 16.1 μ after papillary edema improvement. The difference between the two measurements was statistically significant ( $p < 0.05$ ).

## Conclusions

Optic disc, retinal nerve and ganglion cell layers are affected by optic disc edema. Optic disc edema due to PTC is defined as papilledema.

There are two different types of stimuli, flash VEP and pattern VEP. Pattern VEP is used to determine organic lesion in the upper visual pathways. Visual cortex neurons are more sensitive to the lines and corners than the flash. Therefore checkerboard pattern form stimuli used in the pattern VEP. Two negative and two positive waves are obtained in VEP. The most important wave is the p 1 (p100) wave. Normally it occurs in the 100th milliseconds. The amplitude is important for the visual acuity evaluation, latency gains importance for any lesion evaluation. Normally latency may vary 2-5%, amplitude may vary up to 25%. Therefore, latency is a more reliable parameter for any occasion. Pattern VEP is used to assess the function of the optic nerve in the unexplained vision loss, optic nerve disease, neurological diseases, simulation and hysteria, hemianopic field defects, vascular disease [6, 7, 11].

Pattern VEP is a sensitive indicator which shows the optic nerve function. It is used in evaluation of the vision loss and the optic nerve damage which is the most important complication of PTC [8]. There is correlation between the CSF pressure and VEP latency period. After the PTC treatment and papilledema improvement, the p 100 latency shortening was detected in the VEP test [8-12]. However, the elongation of the p100 latency time is permanent in chronic papilledema due to the deterioration of the optic nerve function and optic neuropathy development. In our study, appropriate with this condition, the shortening of latency in P 100 wave has been detected in the recovery period, although not statistically significant that compared with the acute phase.

Different pathophysiological mechanisms may play a role in the development of optic disc edema. According to this condition, variation in RNFL measurements is shown in the literature [14-16]. Initially, the papilledema due to PTC does not disrupt the function of the retinal nerve fiber layer but edema affects RNFL by the time. Menke et al. [17] reported that increased RNFL measurement in disc edema is multifactorial, the optic disc edema due to inflammatory processes affects only retinal nerve fiber layer thickness and ganglion cell layer. In the optic disc edema secondary to atherosclerosis, increased thickness may be measured in all retinal layers. Ophir et al in their study, in chronic papilledema patients the mean peripapillary RNFL measurement is higher when compared to normal control group [18]. In studies done by Ibrahimov et al, in PTS patients that have papilledema RNFL was significantly higher than the control group. In our study, the difference between the acute phase and improvement period was found statistically significant. RNFL increases at the initial phase of the disease that accompanying with the papilledema, a significant reduction was observed in the recovery period.

Initially, the papilledema does not disrupt the function of the retinal nerve fiber layer, but it may cause prolongation of the P100 wave latency and an increase in RNFL. After the papilledema effects elimination, the changes in the optic nerve and RNFL improve. If papilledema is not treated, ischemic symptoms may occur with the effect of pressure on the retinal nerve fiber layer. Therefore, early diagnosis and treatment are extremely important.

## Declarations

### Recommendations

Ahmet Sengun, MD, Professor of Ophthalmology, Ufuk University Faculty of Medicine, ANKARA and Dilek Güven, MD, Associate Professor, Chief of Eye Clinic, Şişli Hamidiye Etfal teaching and Research Hospital, Istanbul, Turkey recommend publication of this article.

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## Topics

[optical coherence tomography](#)

[pseudotumor cerebri](#)

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