

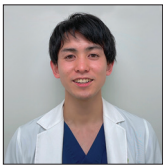
Case Report

Visual-evoked potential predicts the efficacy of the optical canal decompression for traumatic optic nerve neuropathy showing blindness: A case report

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ABSTRACT

Background: The indication for surgical optic canal decompression (OCD) for traumatic optic neuropathy (TON) remains controversial because there is no reliable predictor of a good outcome. We report the case of a blind patient with TON whose remaining visual-evoked potential (VEP) suggested recovery potential of the injured optic nerve after OCD.

Case Description: A 48-year-old man had fallen from a height of 7 m, striking his head. He immediately complained of right-eye blindness. He had no light perception and the direct light reflex disappeared from the right pupil, although there was no fracture or traumatic lesion on computed tomography and magnetic resonance imaging. Because the amplitude of the VEP with the right eye stimulation remained unchanged, we performed the right OCD. During surgical OCD, the amplitude and latency of VEP began to improve. Finally, the visual field improved in almost all directions, and eyesight improved to 0.2.

Conclusion: The retained VEP activity in TON may suggest the recovery potential of the injured optic nerve, even in cases of blindness. It is possible that VEP is an indicator of aggressive treatment for TON such as OCD.

Keywords: Optic canal decompression, Traumatic optic neuropathy, Visual-evoked potential

INTRODUCTION

Traumatic optic neuropathy (TON) is one of the serious complications of craniomaxillofacial trauma, with an incidence of 0.5–2.0% in head trauma, and its visual outcome is poor.^[2,5] TON can be divided into two types: Direct and indirect. Recovery is challenging in patients with direct TON because the optic nerve is directly lacerated, whereas those with indirect type have the chance to recover.^[8,12] Especially for indirect TON, multiple therapeutic options have been proposed, including observation alone, high-dose steroids, surgical optic canal decompression (OCD), and their combinations.^[4] However, the efficacy of these treatments has not been established, and no consensus exists regarding the optimal treatment for TON. Miller said that it is appropriate to observe all patients with TON, except those with compartment syndrome within the orbit or optic nerve sheath.^[9] However, some studies have reported that surgical decompression is more effective than steroid therapy alone because it

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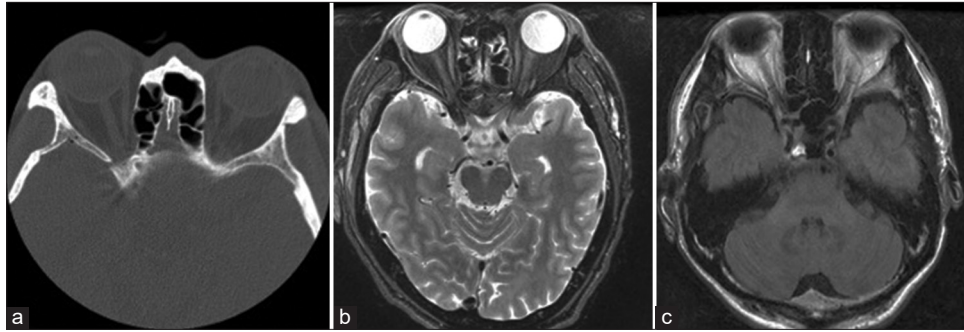


Figure 1: Computed tomography (CT) scan and magnetic resonance imaging (MRI) pre- and post-operatively. Thin-slice CT showing no optic canal fracture (a); MRI showing no intracranial traumatic lesions (b and c).

relieves the constriction of the optic nerve in the osseous structure, especially in cases of optic canal swelling due to edema, hematoma, or nerve swelling.^[3,14] However, surgical results vary because there are no reliable criteria for surgical indication.^[15]

We report a unilateral TON case complaining of blindness showing approximately 50% visual-evoked potential (VEP) activity, where VEP had begun to recover immediately after decompression during OCD operation. This is the first report to suggest that VEP may be a reliable indicator of OCD operation for TON.

CLINICAL REPORT

A 48-year-old man fell from a height of 7 m while working, striking his head, and losing sight completely in his right eye immediately afterward. His consciousness score was 14 points on the Glasgow Coma Scale (E6 V4 M4); his right pupil was 7 mm, and his left pupil was 3 mm. He had no light perception and the direct light reflex disappeared in the right pupil. There were no fractures or traumatic lesions on the head thin-slice computed tomography and magnetic resonance imaging [Figures 1a-c]. The amplitude of the flash VEP with right-sided stimulation was not zero; however, it was approximately 45% lower than that with left-sided stimulation [Figure 2]. We considered that TON resulted in right blindness, while VEP remained. Therefore, 7 h after the injury, we performed right OCD through frontotemporal craniotomy [Figures 3a and b] with intraoperative flash VEP. There was a bone fracture at the optic canal roof but no injury to the optic nerve. We drilled the roof of the optic canal, and we found an improvement of VEP from 2.1 μ V to 6.1 μ V at L0, from 4.5 μ V to 9.5 μ V at M0, and from 4.3 μ V to 10.4 μ V at R0. VEP with right-sided stimulation has finally improved to 80% of contralateral VEP after drilling [Figure 4]. Post-operatively, high-dose steroid therapy was initiated, and the patient's visual function improved over time. On post-operative day 30, his right eyesight was 0.2 and he could see

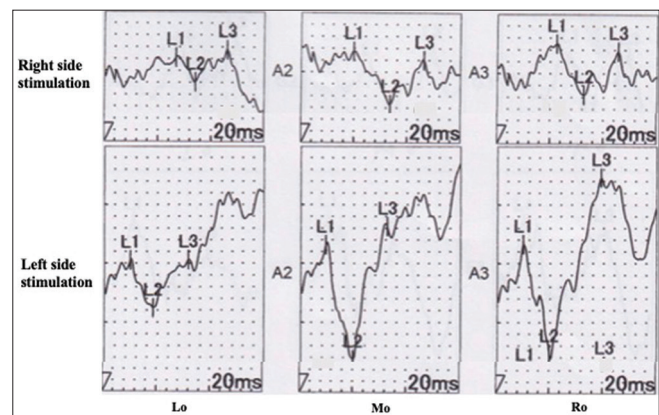


Figure 2: Visual-evoked potential at admission. The mid-occipital electrode (Mo) is placed above the external occipital protuberance (inion). Lateral occipital electrodes (Lo and Ro) are placed 4 cm to the left and right to the Mo.

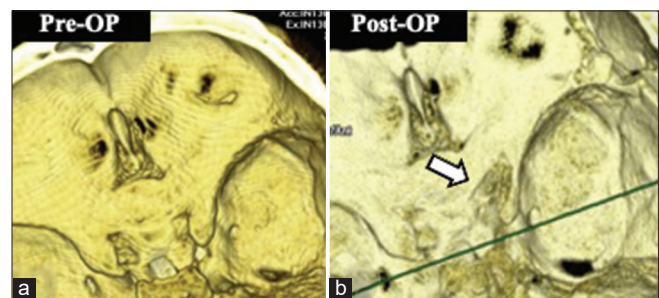


Figure 3: Pre- and post-operation three-dimensional images of optic canal decompression (a and b). White arrow indicates the decompressed optic canal.

all directions except for the central field of view, as shown in Figure 5. At present, he can work normally because his eyesight and visual field have improved.

DISCUSSION

TON, which occurs in up to 2% of patients after head trauma, is classified into direct and indirect injuries.^[2,13] Direct

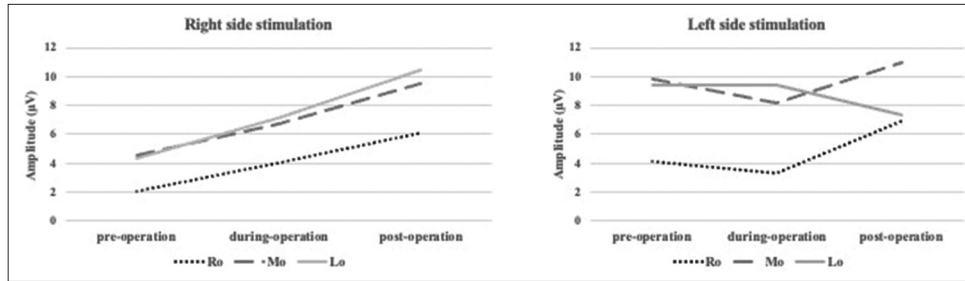


Figure 4: Changes of visual-evoked potential during operation and follow-up time. After craniotomy and drilling out of the optic canal, the amplitude increased at all electrodes in the right-sided stimulation. The final measurement improved from 2.1 μV to 6.1 μV at L0 (Left occipital electrode), from 4.5 μV to 9.5 μV at M0 (Middle occipital electrode), and from 4.3 μV to 10.4 μV at R0 (Right occipital electrode).

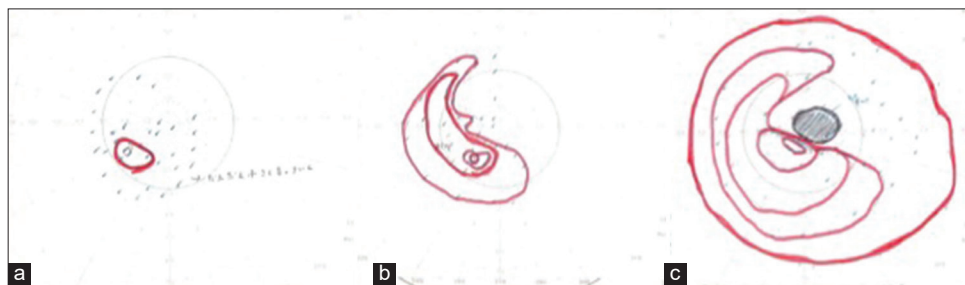


Figure 5: Change in the visual field of the right eye by Goldmann visual field meter. (a) Pre-operatively. (b) Post-operatively. (c) Thirty days after the operation, vision was restored in all directions, except for the central field of view.

injuries, caused by a penetrating injury to the optic nerve area, result in poor visual recovery.^[16] Indirect optic nerve injuries are caused by an impact shearing force transmitted to the optic nerve axons or nutrient vessels of the optic nerve.^[13] It may also occur after the force of impact because of vasospasm and swelling of the optic nerve within the confines of the non-expandable optic canal.^[11] Indirect damage to the optic nerve is the most common form of TON, and this indirect type of TON is associated with a greater chance of recovery. However, even now, the best treatments for TON with complete blindness are observation, high-dose steroids, surgical OCD, and their combinations. Some predictors of functional outcomes have been reported, and it is clear that the initial eyesight strongly predicts visual outcomes.^[16] Thus, if the patient complained of blindness at admission, we considered the outcome to be severe and did not choose aggressive invasive treatments such as OCD. In this case, VEP activity persisted despite blindness and visual function recovered immediately after surgical OCD. VEP and electroretinograms have been used to evaluate the functional status and stability of visual pathways.^[10] Moreover, it can help to determine the prognosis of suspected cases. Although Holmes and Sires reported that VEP might predict visual prognosis and degree of recovery, there are no reports on the use of VEP to indicate surgical OCD for TON.^[1,6,7] We suggest that VEP is useful as an indication for active treatment, even for blind TON cases, especially surgical OCD.

Fortunately, in our case, VEP activity persisted; however, the degree to which VEP activity contributed to the good outcome is unclear. According to some reports, in unilateral cases of TON, a flash VEP amplitude ratio (affected side to normal side) >0.5 appears favorable visual outcome.^[7] Thus, 50% of unaffected side VEP might be a critical value; however, there are some questions: How to determine the critical level in bilateral TON cases; what is the outcome of the case showing under 50% VEP; and so on? More case studies and data are required in the future.

CONCLUSION

The retained VEP activity in TON may suggest the recovery potential of the injured optic nerve, even in cases of blindness. It is possible that VEP is an indicator of aggressive treatment for TON such as OCD.

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Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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