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Usefulness of MRI Slices Parallel to the Optic Chiasma in a Case with Traumatic Optic Nerve Avulsion after a Bear Attack

Akira TAMASE,[1] Osamu TACHIBANA,[1] and Hideaki IIZUKA[1]

[1]*Department of Neurosurgery, Kanazawa Medical University, Uchinada-machi, Ishikawa, Japan*

Abstract

Optic nerve avulsion is an exceedingly rare condition. Here, we describe a case of optic nerve avulsion in a 74-year-old man with temporal hemianopia in the contralateral eye after a bear attack. Magnetic resonance imaging (MRI) revealed separation of the optic nerve distal to the optic chiasma, whereas the high signal in diffusion-weighted imaging suggested nerve injury from the left side of the optic chiasma to the left optic tract. MRI slices parallel to the optic chiasma were obtained and used for evaluating the site of optic nerve avulsion and nerve injury, which were responsible for temporal hemianopia in the contralateral eye.

Key words: MRI slice, optic chiasma, optic nerve avulsion

Introduction

Optic nerve avulsion is exceedingly rare and can be caused by severe facial trauma, martial arts maneuvers, or self-inflicted behavior.[1)] Here, we describe a case of traumatic optic nerve avulsion with temporal hemianopia in the contralateral eye. We used magnetic resonance imaging (MRI) to definitively identify the site of the optic nerve avulsion and assess damage to the optic chiasma and optic tract, which were responsible for the temporal hemianopia in the contralateral eye.

Case Report

A 74-year-old man was attacked by a bear in a hunting episode during which his face was clawed at by the bear. He was brought to our hospital, and on arrival, his left forehead, left orbit, and left cheek showed deep crush wounds and his left eye was lost. He immediately received an injection of tetanus toxoid. The wound was sutured by plastic surgeons without debridement after reconstruction of lacrimal tract. Intravenous cefazolin infusion was performed at 1 g × three times daily for 11 days. There was no cerebrospinal fluid leakage. On hospitalization, he experienced a temporal visual field defect in his right eye (Fig. 1). Seven days after the trauma, MRI was performed such that 2-mm thick slices parallel to the optic chiasma (Fig. 2A) were obtained; on comparing these images with the coronal and sagittal sections, the MRI images clearly showed tearing of the left optic nerve distal to the optic chiasma (Fig. 2B). Additionally, a high diffusion-weighted imaging (DWI) signal from the left side of the optic chiasma to the left optic tract indicated nerve injury (Fig. 2C). Three months after discharge, the routine MRI revealed degenerative regression from the left side of the optic chiasma to the left optic tract (Fig. 2D) and an unchanged temporal hemianopia in the right eye.

Discussion

Optic nerve avulsion causing visual impairment in the contralateral side of the injured eye has been reported in the literature.[2,3)] In our case, traction was added to the left optic nerve, thereby causing avulsion at a site just distal to the optic chiasma. In addition, there was nerve injury to the left side of the optic chiasma and the left optic tract, which was present on the same vector as the traction power, and together, this may have caused the temporal hemianopia in the right eye.

The site of the optic nerve avulsion was confirmed using conventional MRI views (axial, sagittal and

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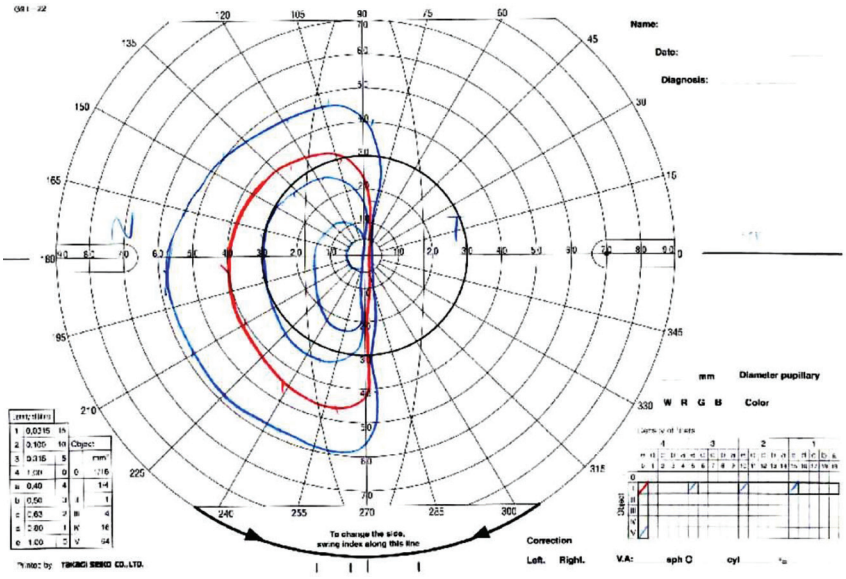

Fig. 1 Goldmann visual field examination of the right eye indicating a complete temporal defect.

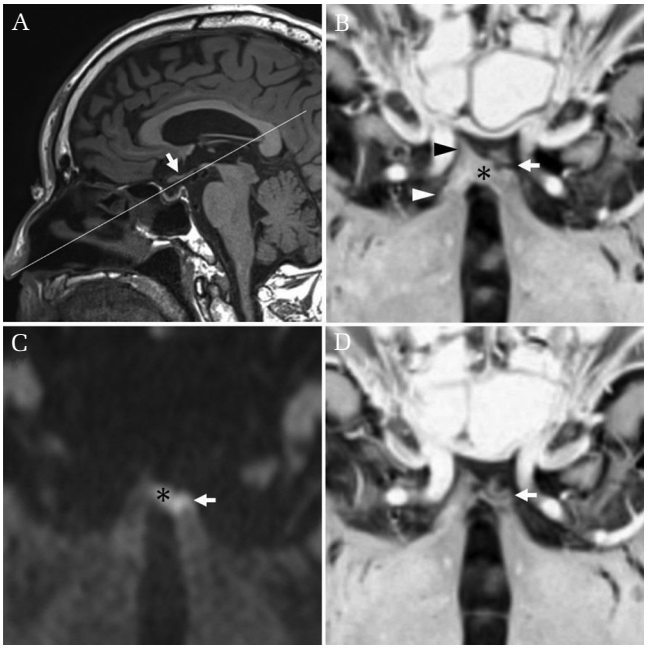

Fig. 2 The optic nerve, optic chiasma, and optic tract were assessed by magnetic resonance imaging (MRI). (A) MRI was performed such that 2-mm slices parallel to the optic chiasma were obtained (*arrow*). (B) At the level of the optic chiasma (*asterisk*), heavily T_2-weighted MRI shows separation of the left optic nerve just distal to the optic chiasma (*arrow*). The right optic nerve and right optic tract are indicated by *black* and *white arrowheads*, respectively. (C) At the same level, a diffusion-weighted image shows nerve injury from the left side of the optic chiasma (*asterisk*) to the left optic tract (*arrow*). (D) At 3 months after the injury, heavily T_2-weighted MRI shows degenerative regression in the left side of the optic chiasma and the optic tract (*arrow*).

coronal). However, to thoroughly evaluate the optic chiasma, we performed heavily T_2-weighted MRIs such that the slices were parallel to the optic chiasma. The rate of detection of the anterior optic pathways was very high (95%) in these images,[4] and this could be attributed to the finer perceptual contrast in grayscale inverted images, shorter imaging times with a resultant reduction in motion artifacts, and the use of a peripheral pulse-gating system that reduces cerebrospinal fluid flow-related artifacts.[5]

We confirmed the site of nerve injury from the left side of the optic chiasma to the left optic tract using high DWI signals. Water diffusion in normal white matter is anisotropic and occurs in a direction parallel to the axon. When axons are injured, diffusion at the site of injury becomes unrestricted and isotropic, which tends to decrease axial diffusivity (AD) and increase radial diffusivity (RD). Further, axonal swelling in cytotoxic edema and reduction in the extracellular space that occur secondary to cell swelling also restrict water diffusion.[6,7] Thus, AD, RD, and mean diffusivity can be comprehensively determined based on these effects. Regarding the signal change over time, Mac Donald et al.[8] reported that AD significantly decreases in the period between 6 h and 4 days after trauma and that it is "pseudo-normalized," whereas RD increases in 1–4 weeks after the trauma, depending on the degree of injury. In our case, the DWI signal on MRI 7 days after the trauma may have been influenced by the severe cytotoxic edema caused by the strong force that led to the optic nerve avulsion.

The heavily T_2-weighted imaging and DWI slices parallel to the optic chiasma clearly identified the

site of the optic nerve avulsion, along with damage to the optic chiasma and the optic tract in the same plane. Thus, our findings suggest that this lesion caused the temporal hemianopia in the contralateral eye.

Conflicts of Interest Disclosure

The authors have no conflicts of interest.

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Address reprint requests to: Akira Tamase, MD, PhD, Department of Neurosurgery, Kanazawa Medical University, 1-1 Daigaku, Uchinada-machi, Kahoku-gun, Ishikawa 920-0265, Japan.
e-mail: reo55555@gmail.com