American Journal of Ophthalmology Case Reports 32 (2023) 101877

Contents lists available at ScienceDirect

American Journal of Ophthalmology Case Reports

journal homepage: www.ajocasereports.com/

A case of functional visual loss diagnosed through bilateral randomized visual field testing with a trick method

Yuki Takagi, Sho Yokoyama *, Yoshimi Yokoyama, Kenta Hozumi, Tatsushi Kaga

Department of Ophthalmology, Japan Community Healthcare Organization Chukyo Hospital, Nagoya, Japan

ARTICLE INFO

Keywords:
Functional visual loss
Imo
Bilateral randomized visual field test
Trick

ABSTRACT

Purpose: To report a case of functional visual loss (FVL) diagnosed through bilateral randomized visual field testing using Imo vifa with a trick method.

Observations: A 27-year-old man complained of visual field abnormality in his left eye after falling from a height of 4 m. The left eye had a best-corrected visual acuity (BCVA) of 20/16 and a critical flicker frequency (CFF) of 44.5 Hz at the first visit. Commotio retinae was observed in the inferior retina of the left eye, and the pupillary light reflex was normal. Computed tomography and magnetic resonance imaging of the head revealed no abnormalities. However, the Goldmann perimeter (GP) showed constriction of visual field in the left eye. Since traumatic optic neuropathy was suspected initially; therefore, two courses of methylprednisolone pulse therapy were administered. However, the BCVA and CFF gradually worsened to 20/200 and 14 Hz, respectively. Nevertheless, his pupillary light reflex was still normal, and GP showed a spiral visual field. Thus, we suspected that this was a case of FVL and performed bilateral randomized visual field testing using Imo vifa in three steps as a trick method. In the first step, we performed the normal method for bilateral randomized visual field testing. In the second and third steps, we explained to the patient that only the right or left eye would be examined on purpose; bilateral randomized visual field testing was then performed. The results of examinations revealed left homonymous hemianopsias and normal and concentric contraction of the visual field in both eyes. These results could not be explained by organic disease, and the patient was diagnosed with FVL.

Conclusions and Importance: Bilateral randomized visual field testing using Imo vifa with a trick method was useful for diagnosing FVL.

1. Introduction

Functional visual loss (FVL) is a decrease in visual acuity and/or visual field that is not caused by any organic lesion. Although it can occur at any age, the peak incidence is observed in children and teenagers. Moreover, FVL is also more common in women.[1–3] The onset may be unprovoked, associated with trauma or psychiatric diseases, or triggered by organic diseases.[1–4] The characteristics of FVL commonly present as contradictory results among examinations. Therefore, visual acuity tests using a trick method (such as the use of a plane lens and a combination of convex/concave lenses to counteract refractive power), visual field tests, and examination for stereoscopic vision are useful for diagnosing FVL.[5] The most common visual field complaint is a concentric loss of the peripheral visual field, described as "tunnel vision." Tunnel vision is characterized by a narrowing of the visual field leading to a constriction of 5–10° centrally; however, the area of visual fields does not change appropriately with the changes in visual distance.[6] The presence of tunnel vision can be confirmed via confrontation testing at different distances and the classic configuration on tangent screen testing. The Goldmann perimeter (GP) with manually dynamic isopters creates a similar constriction with a non-physiologic overlap of the isopters (small dark and large bright objects at the same place). Alternatively, continuous spiral or a jagged inconsistent star pattern have also been reported.[7] Humphrey Field Analyzer (HFA) and other static automatic perimeters (SAPs) are not useful for diagnosing FVL in general.[8] Therefore, GP can be considered more useful than SAP for diagnosing FVL. However, the detection of these visual field dysfunctions is difficult and relies on the examiner's skill. In addition, there have been various reports on the visual field in patients with FVL, such as hemianopsias on binocular visual field test[5,9], no visual field

* Corresponding author. Department of Ophthalmology, Japan Community Healthcare Organization Chukyo Hospital, 1-1-10 Sanjo, Minami-ku, Nagoya-city, Aichi prefecture, Japan.

E-mail address: yokoyama@chukyogroup.jp (S. Yokoyama).

https://doi.org/10.1016/j.ajoc.2023.101877
Received 23 December 2022; Received in revised form 10 May 2023; Accepted 15 June 2023
Available online 22 June 2023

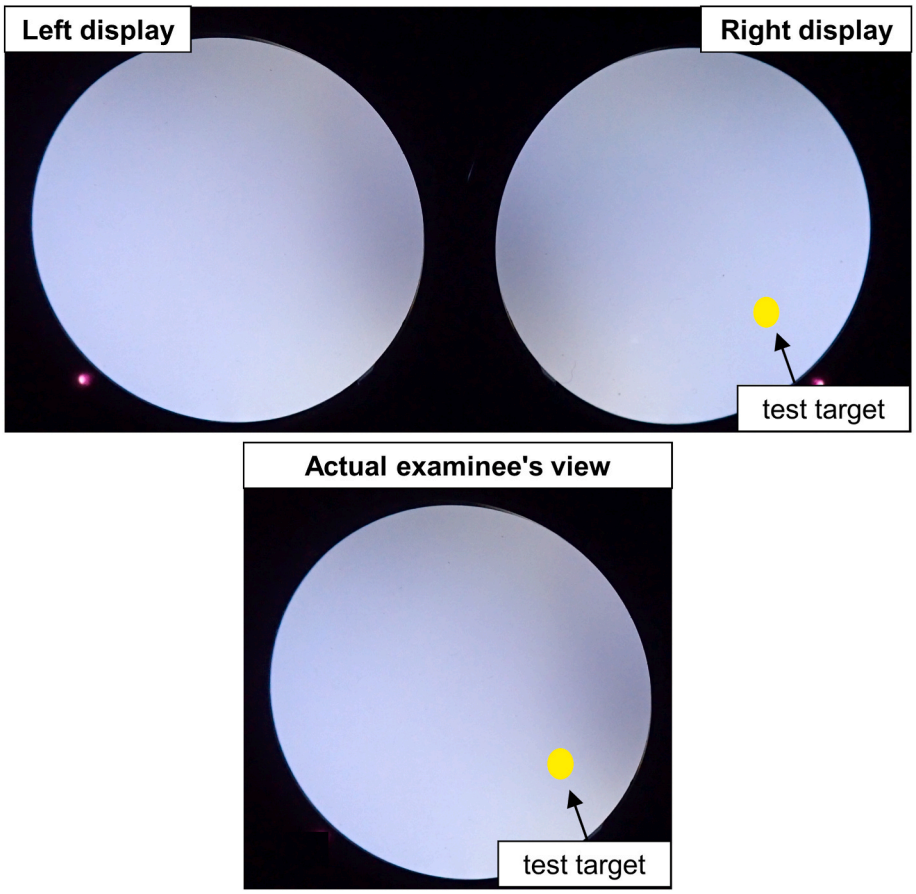

Fig. 1. Fig. 1. Bilateral randomized visual field testing is performed under non-occlusion condition in both eyes and the right and left eyes simultaneously view independent displays. The test target is then randomly displayed to the left or right eyes. Since the examinee has both eyes open, the test target is perceived to be in a single field of vision.

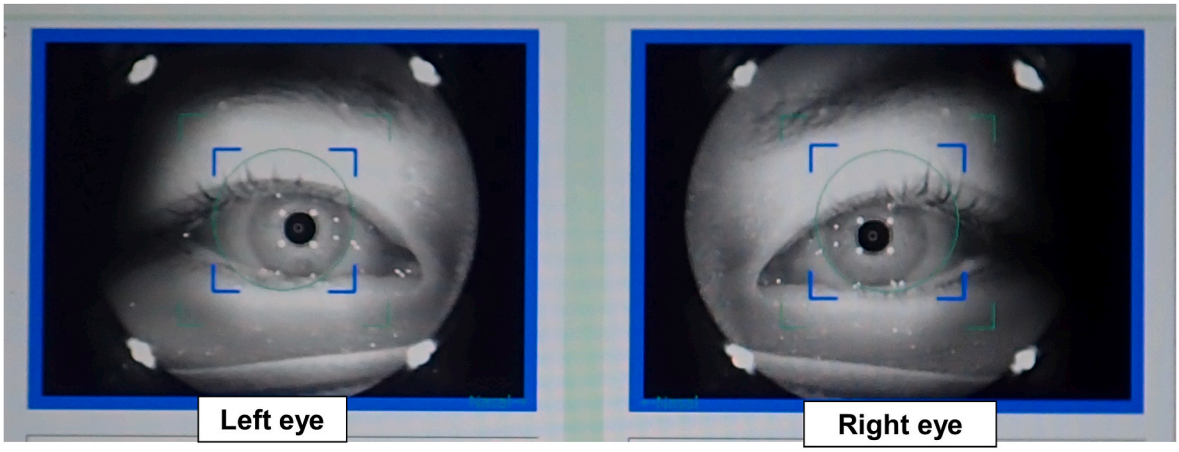

Fig. 2. Monitoring of eye fixation in Imo and Imo vifa. The examiner can monitor eye fixation and intentional eyelid closure.

dysfunction, or nonspecific visual field dysfunction.[1,2] Additionally, in some cases, FVL may be difficult to differentiate from optic neuropathy.

The head-mounted perimeter (Imo, CREWT Medical Systems, Tokyo, Japan) is used to examine bilateral randomized visual field testing. The visual field examined by Imo highly correlated with the HFA, and the examination time of Imo is shorter than that of HFA.[10–12] Imo vifa (CREWT Medical Systems, Tokyo, Japan) is an improved version of Imo, a stationary visual field analyzer that is easier to prepare for examination. Similar to Imo, Imo vifa can be used for bilateral randomized visual field testing. Bilateral randomized visual field testing using Imo/Imo vifa is performed under non-occlusion conditions; thus, the occlusion of one eye, as in HFA, is not required. Independent displays are used for the right and left eyes, and the targets are randomly shown to the left or right eye. However, since both eyes of the examinee are open, the targets are perceived to be presented in a single field of view (Fig. 1). Consequently, patients are unable to recognize which eye is being examined during bilateral randomized visual field testing using Imo.[9] During the examination, an image of the examinee's pupils is displayed on the

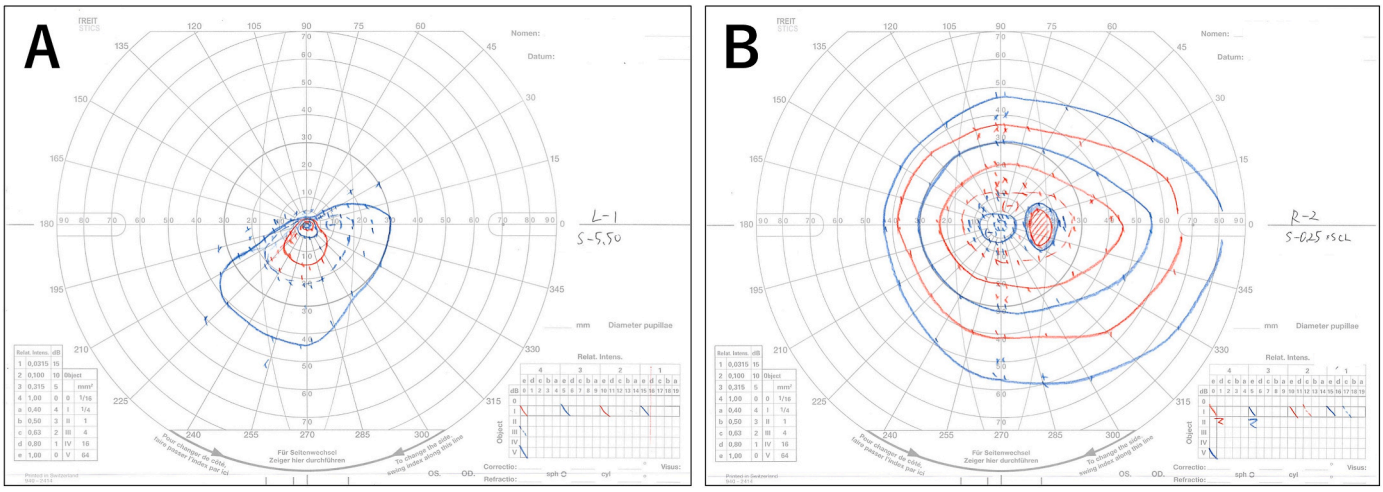

Fig. 3. The Goldmann perimeter at 4 days after injury. A: The left eye. B: The right eye. Constriction of visual field in the left eye (A) and normal visual field in the right eye (B).

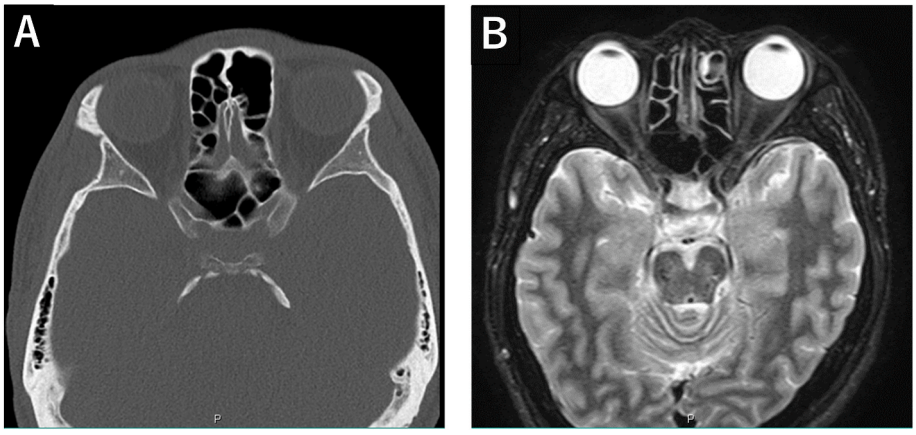

Fig. 4. Imaging findings of the head at the first visit after injury. A: Computed tomography scan of the head. There is no abnormality, such as bone fracture of the optic nerve canal. B: Magnetic resonance imaging of the head. There is no abnormality, such as hematoma of the optic nerve canal.

monitor in real time, thereby enabling the examiner to monitor the state of fixation and whether the eyes are closed intentionally (Fig. 2). Thus, we believe that this characteristic may be useful for diagnosing FVL and malingering.[13]

Few studies have reported on the efficacy of Imo/Imo vifa for diagnosing FVL, and the examination procedure has not been established. In this report, we present a case of trauma-induced visual impairment that was difficult to differentiate from traumatic optic neuropathy; however, we were able to diagnose FVL using Imo vifa with a trick method.

2. Case presentation

A 27-year-old man complained of visual field abnormality in his left eye after falling from a height of 4 m. The left eye had a best-corrected visual acuity (BCVA) of 20/16 at the first visit. Commotio retinae was observed in the inferior retina of the left eye; no other abnormalities were observed in his eyes. GP results obtained 4 days after the injury revealed constriction of visual fields in the left eye (Fig. 3). Traumatic optic neuropathy was suspected. However, the left eye had a critical flicker frequency (CFF) of 44.5 Hz at the first visit, and the pupillary light reflex was normal. Computed tomography and magnetic resonance imaging of the head did not reveal abnormalities, such as bone fracture of the optic nerve canal (Fig. 4). The possibility of traumatic optic neuropathy could not be ruled out at the time of initial examination; therefore, two courses of methylprednisolone pulse therapy were administered (1000 mg/day for 3 days).

However, the patient's visual awareness did not improve, and his BCVA and CFF gradually worsened to 20/200 and 14 Hz, respectively, after methylprednisolone pulse therapy (Fig. 5). Nevertheless, his pupillary light reflex remained normal, and GP showed a spiral visual field (Fig. 6). Therefore, we suspected FVL and performed a visual acuity test using a trick method (such as the use of a plane lens and a combination of convex and concave lenses to counteract refractive power). However, the patient's visual acuity did not improve using the trick method. Subsequently, we performed bilateral randomized visual field testing using Imo vifa in three steps as a trick method. In the first step, we performed the normal method for bilateral randomized visual field testing (the program was 30-2). In the second and third steps, we explained to the patient that only the right or left eye would be examined on purpose, and bilateral randomized visual field testing was then performed (the second and third step programs were 24-2 and 24-2 plus 1, respectively). The result of the examination in the first step revealed left homonymous hemianopsias (Fig. 7). The second step revealed normal results; however, the third step revealed concentric contraction of the visual field in both eyes (Figs. 8 and 9). These results contradict those of organic diseases. Malingering, where the patient himself intentionally adjusts his vision and CFF to decrease, was a possibility in this case since vision and CFF decrease are correlated. The examiner

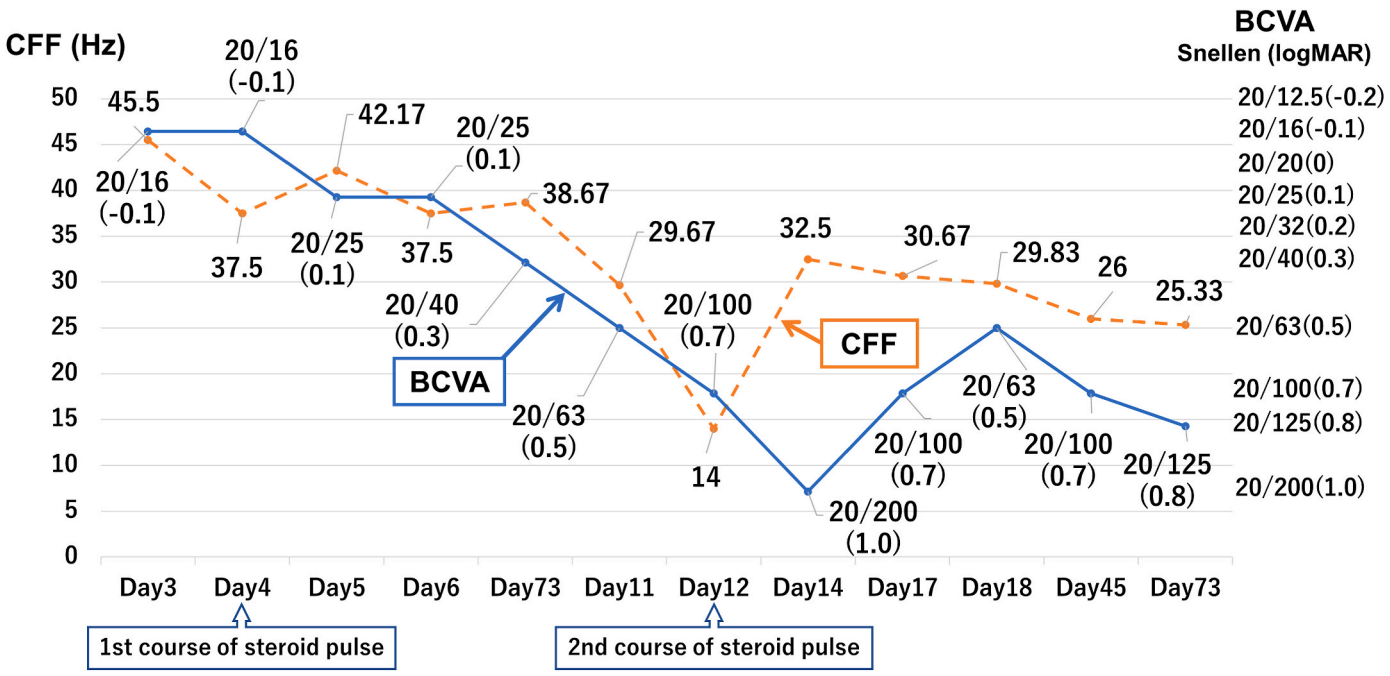

Fig. 5. The diagram of the progression of the best-corrected visual acuity (BCVA) and critical flicker frequency (CFF) during treatment (the dotted line represents CFF and the solid line represents BCVA). BCVA is presented as Snellen visual acuity and logarithmic minimum angle of resolution (LogMAR). The patient's visual awareness did not improve, and BCVA and CFF gradually worsened during methylprednisolone pulse therapy.

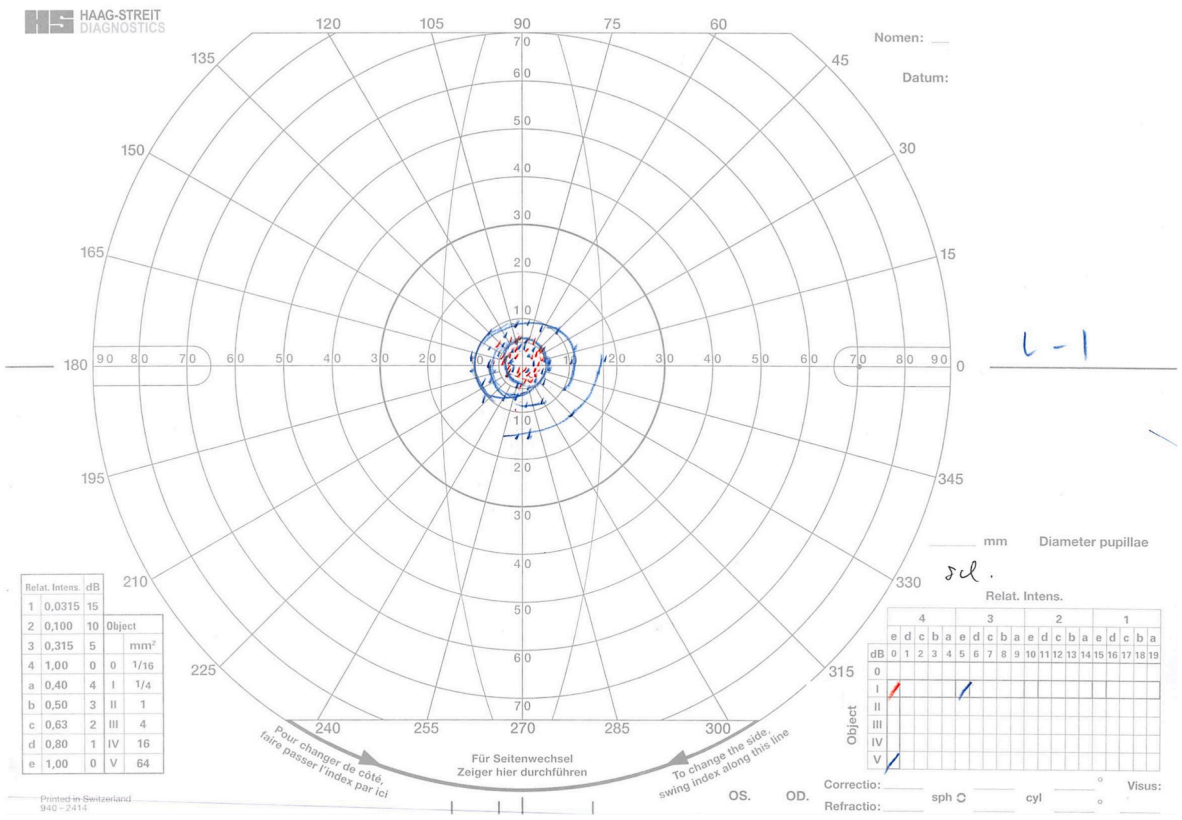

Fig. 6. The Goldmann perimeter after methylprednisolone pulse therapy of the left eye. It showed a spiral visual field.

monitored the open eyes during bilateral randomized visual field testing with the trick method; however, there was no indication that the examinee closed his eyes intentionally. Therefore, we considered it impossible to intentionally cause visual field defects such as those observed in this case and concluded that the patient was not malingering. The patient was diagnosed with FVL and he was observed without additional methylprednisolone therapy. The BCVA and CFF (20/200 and 25.33 Hz, respectively) of the patient did not show any

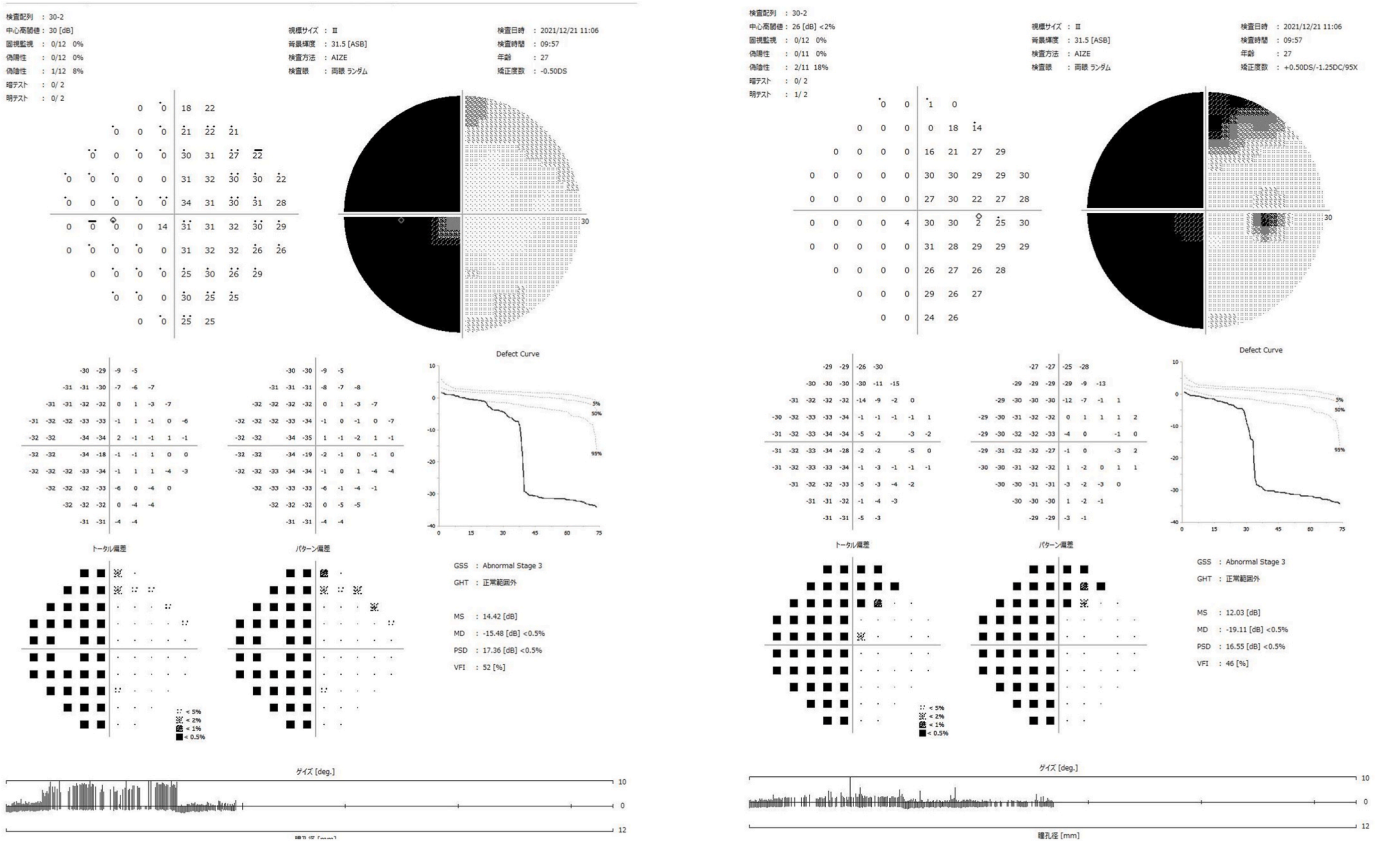

Fig. 7. The first step of examination using Imo vifa using the normal method for bilateral randomized visual field testing (the program was 30-2). The right figure is the result for the right eye, and the left figure is the result for the left eye. The patient had left homonymous hemianopsias.

improvement 6 months after the injury at the final visit, after which he did not visit our hospital.

3. Discussion

In the present case, the patient complained of visual dysfunction after the injury; thus, traumatic optic neuropathy could not be ruled out at the first visit. In addition, FVL may be difficult to diagnose because this patient did not show improvement in visual acuity on the visual acuity test using the trick method. In general, the results of visual field testing correspond to structural abnormalities in related diseases. However, FVL presents with visual field defects despite the absence of structural abnormalities. In addition, it is characterized by a lack of correspondence between structural and visual field abnormalities. In the present case, the result of normal bilateral concurrent examination (first step) revealed left homonymous hemianopsias. This may presumably be due to the patient's perception of left-side blindness and inability to identify which eye was tested in the bilateral randomized visual field test using Imo vifa. Previous reports[5,9] also showed that patients with FVL presented with hemianopsias on the side of the patient's perception of blindness on the binocular visual field test. The results of visual field tests, such as hemianopsias in previous reports and the present case, presumably occurred through the same mechanism. In the second step of the examination, the patient was informed that only the right eye would be examined; bilateral randomized visual field testing was performed in practice and revealed normal visual fields in both eyes. The patient only recognized the right eye examination, which might have affected the results of the normal visual fields in both eyes. In the third step of the examination, the patient was informed that only the left eye would be examined; bilateral randomized visual field testing revealed concentric contraction of the visual fields in both eyes. The patient only recognized the left eye examination, which might have affected the concentric contraction of the visual fields in both eyes. Presumably, these results were obtained not because of organic diseases or characteristics of FVL diseases, indicating that bilateral randomized visual field testing using the trick method is effective in diagnosing FVL.

A previous report[13] showed that the visual field abnormality observed with GP and HFA disappeared in the bilateral randomized visual field test using Imo in the case of FVL. However, left hemianopsias was observed in the first step of the bilateral randomized visual field test using the Imo vifa in our present case. This discrepancy may be due to the perception that the affected eye should not be visible, and all visible optic targets were perceived as examinations of the healthy eye, resulting in normal results for both eyes.

The result of the second-step examination described only the right eye; however, bilateral randomized visual field testing revealed normal visual fields in both eyes. Thus, the results of bilateral randomized visual field testing with Imo/Imo vifa for FVL diagnosis may differ depending on the patient's recognition of whether the affected or healthy eye is being tested.

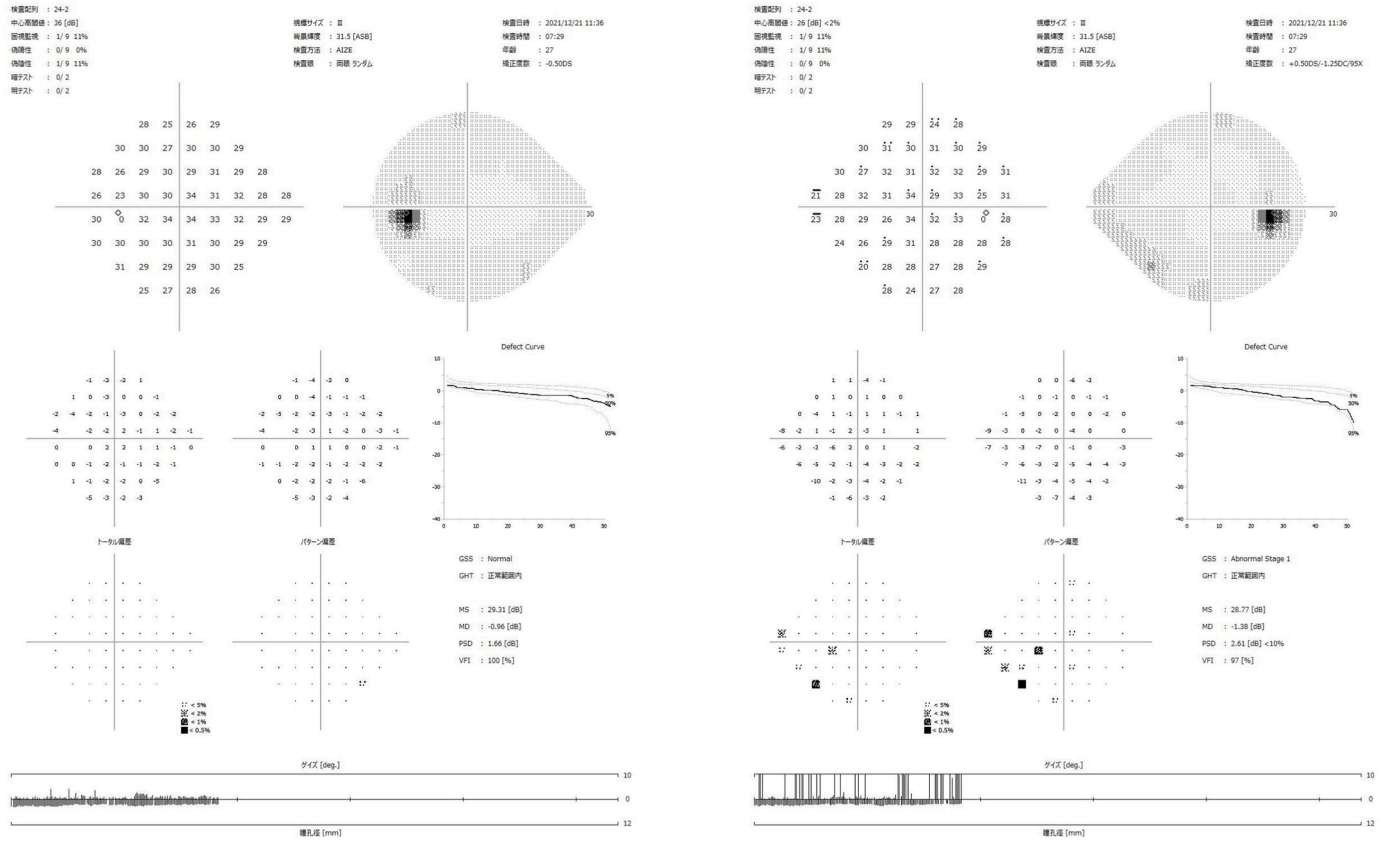

Fig. 8. The second step of the examination using Imo vifa. We explained to the patient that only the right eye would be examined; however, we actually performed bilateral randomized visual field testing (the program was 24-2). The right figure is the result for the right eye, and the left figure is the result for the left eye. It showed normal visual fields in both eyes.

In the present study, the test patterns were changed to evaluate the optimal examination conditions. The test pattern of the third step (24-2 plus 1) was the screening mode. It was faster than 30-2 and 24-2, and the number of optimal measurement points was reduced. Moreover, 24-2 plus 1 was able to detect visual field abnormalities in the present case. This indicated that 24-2 plus 1 might be effective in diagnosing FVL, despite having a shorter examination time than 30-2 and 24-2.

Nevertheless, this case still has limitations. The patient was not examined using HFA; hence, we could not compare the results of the Imo vifa and HFA. The results of HFA were probably normal visual field in the right eye and concentric contraction of the visual field in the left eye, such as the GP, because the patient could distinguish which eye was examined when visual field tests were performed using the HFA and GP. A previous report[10] and this case indicated that FVL has some patterns of visual field change in bilateral randomized visual field tests. Therefore, more cases must be examined to determine the patterns of visual field changes and the effectiveness of visual field tests using the trick method. In addition, this case suggested that bilateral randomized visual field testing using Imo vifa with a trick method may be useful in diagnosing FVL. However, GP presents continuous spiral or a jagged inconsistent star pattern in patients with FVL, and these visual field changes are difficult to detect through static visual field testing. Therefore, the technique used in this case is not a replacement for GP, and it would be preferable to continue performing GP in cases of FVL.

4. Conclusions

Imo and Imo vifa may be used for bilateral randomized visual field testing, and the patient could not recognize which eye was examined during the visual field testing. We utilized this characteristic of Imo vifa and concluded that bilateral randomized visual field testing using Imo vifa with a trick method was useful for diagnosing FVL.

Patient consent

We hereby acknowledge that the patient provided written informed consent for reporting the examination and imaging findings as deemed necessary for diagnosis, education, research, and quality improvement.

Funding

No funding or grant support.

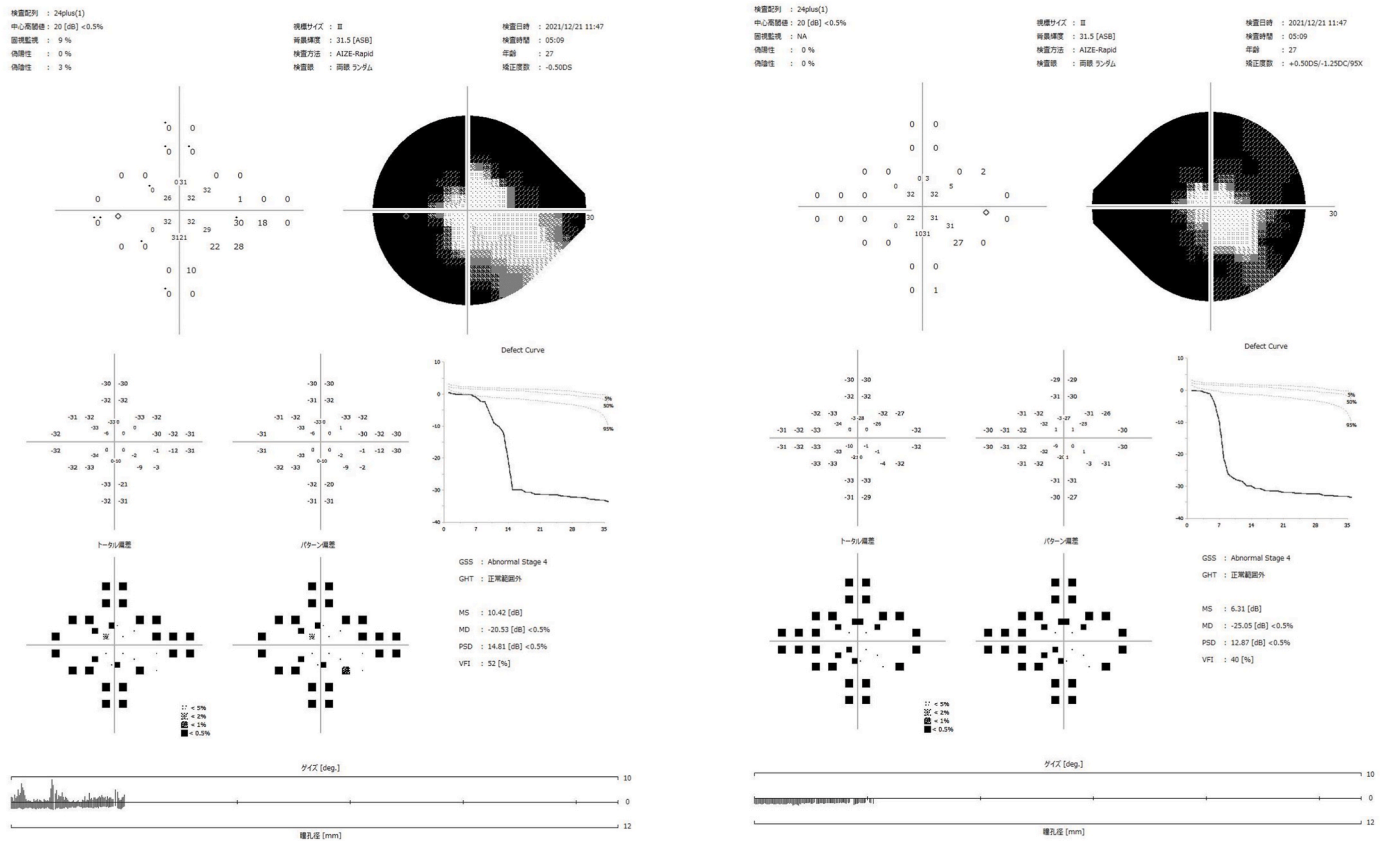

Fig. 9. The third step of the examination using Imo vifa. We explained to the patient that only the left eye would be examined; however, we actually performed bilateral concurrent examination (the program was 24-2 plus 1). The right figure is the result for the right eye, and the left figure is the result for the left eye. It showed concentric contraction of the visual fields in both eyes.

Authorship

All authors attest that they meet the current ICMJE criteria for Authorship.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgements

We would like to thank Editage (www.editage.com) for English language editing.

References

1. Scott JA, Egan RA. Prevalence of organic neuro ophthalmologic disease in patients with functional visual loss. *Am J Ophthalmol*. 2003;135(5):670–675.
2. Lim SA, Siatkowski RM, Farris BK. Functional visual loss in adults and children patient characteristics, management, and outcomes. *Ophthalmology*. 2005;112(10):1821–1828.
3. Mäntyjärvi MI. The amblyopic schoolgirl syndrome. *J Pediatr Ophthalmol Strabismus*. 1981;18(6):30–33.
4. Hirai T, Sato M, Kachi S, et al. Similar etiologies of functional visual loss observed in children and adults. *Binocul Vis Strabismus Q*. 2005;20(4):218–223.
5. Bruce BB, Newman NJ. Functional visual loss. *Neurol Clin*. 2010;28(3):789–802.
6. Smith CH, Beck RW, Mills RP. Functional disease in neuro-ophthalmology. *Neurol Clin*. 1983;1(4):955–971.
7. Newman NJ. Neuro-ophthalmology and psychiatry. *Gen Hosp Psychiatr*. 1993;15(2):102–114.
8. Smith TJ, Baker RS. Perimetric findings in functional disorders using automated techniques. *Ophthalmology*. 1987;94(12):1562–1566.
9. Keane JR. Hysterical hemianopia. The 'missing half' field defect. *Arch Ophthalmol*. 1979;97(5):865–866.
10. Kimura T, Matsumoto C, Nomoto H. Comparison of head-mounted perimeter (imo®) and humphrey field analyzer. *Clin Ophthalmol*. 2019;13:501–513.
11. Nakai Y, Bessho K, Shono Y, Taoka K, Nakai Y. Comparison of imo and Humphrey field analyzer perimeters in glaucomatous eyes. *Int J Ophthalmol*. 2021;14(12):1882–1887.
12. Matsumoto C, Yamao S, Nomoto H, et al. Visual field testing with head-mounted perimeter 'imo'. *PLoS One*. 2016;11(8), e0161974.
13. Goseki T, Ishikawa H, Shoji N. Bilateral concurrent eye examination with a head-mounted perimeter for diagnosing functional visual loss. *Neuro Ophthalmol*. 2016;40(6):281–285.