Dissociated Horizontal Deviation after Traumatic Brain Injury

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A 4-year-old boy visited the hospital with exotropia after brain hemorrhage caused by trauma. He had undergone decompressive craniectomy and cranioplasty 18 months prior to presentation at our hospital. An alternate prism cover test showed more than 50 prism diopters (PD) of left exotropia when he was fixing with the right eye and 30 PD of right exotropia when he was fixing with the left eye at near and far distance. On the Hirschberg test, 60 PD of left exotropia was noted in the primary position. Brain computerized tomography imaging performed 18 months prior showed hypodense changes in the right middle cerebral artery and anterior cerebral artery territories. Subfalcian herniation was also noted secondary to swelling of the right hemisphere. The patient underwent a left lateral rectus muscle recession of 7.0 mm and a left medial rectus muscle resection of 3.5 mm. Three weeks after the surgery, the Hirschberg test showed orthotropia. On alternate prism cover testing, 8 PD of left exotropia and 8 PD of right esotropia were noted at distance. We report a patient who developed dissociated horizontal deviation after right subfalcian subdural hemorrhage caused by trauma.

Key Words: Brain injuries, Dissociated horizontal deviation, Wounds and injuries

Dissociated horizontal deviation (DHD) is defined as a change in horizontal ocular alignment, unrelated to accommodation that is brought about solely by a change in the balance of visual input from the two eyes [1]. DHD usually presents in patients who have undergone surgery for infantile esotropia. Binocular decorrelation is a sufficient cause of DHD when imposed during a critical period of stereopsis development [2]. We present an unusual case of DHD developing after brain hemorrhage caused by trauma.

Case Report

A 4-year-old boy developed exotropia after undergoing a decompressive craniectomy for brain hemorrhage because he fell over and bumped his head against the desk, 18 months prior to presentation at our hospital. Brain computed tomography and magnetic resonance imaging performed at that

time showed hypodense changes in the right middle cerebral artery territory and both anterior cerebral artery territories, as well as subfalcian herniation due to swelling of the right hemisphere (Fig. 1).

When he was fixing with the right eye, alternate prism cover test showed more than 50 prism diopters (PD) of the left exotropia was noted. 30 PD exotropia of the right eye was noted when he was fixing with the left eye (Fig. 2, top and middle). Unfortunately, we could not determine if the patient had stereopsis, due to his lack of cooperation. Abnormal head posture and limitation of extraocular motility was not noted. On the forced duction test under general anesthesia, muscle tightening or loosening was not noted.

We treated the patient with left lateral rectus muscle recession of 7.0 mm and left medial rectus muscle resection of 3.5 mm. Three weeks after surgery, the Hirschberg test showed orthotropia (Fig. 2, bottom). Alternate prism cover testing showed 8 PD of left exotropia and 8 PD of right esotropia at distance. Six months after surgery, alternate prism cover testing showed 4 PD of exotropia in the left eye and 2 PD of esotropia in the right eye at distance.

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Fig. 1. (A) Computerized tomography showed hypodense change at right middle cerebral artery, both anterior cerebral artery territory (black arrow) and subfalcian herniation due to swelling of right hemisphere (white arrow). (B) Diffuse magnetic resonance imaging showed high signal at the right frontoparietooccipital lobe which means decreased diffusion and acute infarction.

Fig. 2. Note large temporal deviation of left eyeball about 60 prism diopters (PD) fixing with the right eye (top) and right exotropia of 30 PD fixing with the left eye (middle) preoperatively. A small amount of esodeviation in the right eye and 8 PD of exodeviation in the left eye were noted postoperatively (bottom).

Discussion

Dissociated strabismus is regarded as a marker of early disruption of normal binocular function [2,3], and DHD usually manifests as spontaneous unilateral exodeviation of greater magnitude in one eye. In some instances, fixation with one eye evokes an esodeviation of the other eye during prism and alternate cover testing [1]. DHD is usually present in patients who experienced binocular disruption in early infancy, such as infantile esotropes. Brodsky [4] reviewed 28 patients with consecutive exotropia and found that 50% of patients had DHD. Tychsen [5] studied infant monkeys exposed to binocular decorrelation and found that those exposed at 12 weeks and at 24 weeks had dissociated deviation (dissociated vertical deviation or DHD).

The visual cortex and visual association cortex lie in the occipital lobe of the brain. The visual cortex (V1, striated

cortex) processes visual information from the eyes, while the visual association cortex (V2-V8, extrastriated cortex) processes the more complex data, such as color and movement, and stereopsis. Among all the parts of the cortex, stereoscopic vision depends on the magnocellular pathway in the V4 extrastriate cortex which is located in the right parieto-occipital lobe [6].

The presented patient might have injured the extrastriate cortex, which controls stereoscopic vision. Hence, this case might suggest that dissociated strabismus can develop in patients who have sustained a brain injury. We were not able to test our patient's stereopsis because of poor cooperation. We also question why the patient presented with DHD instead of dissociated vertical deviation (DVD). This may be explained by the difference in brain lesions associated with DHD and DVD, but this possibility needs to be investigated in future studies.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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