Korean J Neurotrauma. 2022 Oct;18(2):329-334
https://doi.org/10.13004/kjnt.2022.18.e64
pISSN 2234-8999·eISSN 2288-2243

KJNT

Case Report

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Unilateral Internuclear Ophthalmoplegia Following Minor Head Injury

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OPEN ACCESS

Received: Aug 3, 2022
Revised: Aug 30, 2022
Accepted: Aug 31, 2022
Published online: Oct 24, 2022

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Conflict of Interest
The authors have no financial conflicts of interest.

ABSTRACT

A lesion in the medial longitudinal fasciculus (MLF) causes internuclear ophthalmoplegia (INO). Many intracranial lesions, such as multiple sclerosis or vascular disorders may be associated with INO; however, INO is a rare complication of minor head injury. The mechanism underlying injury to the MLF may be shear force on the brain stem during head trauma. The shear force can tear or stretch the fibers of the MLF and can also lead to compromise or rupture of the perforating branches of the basilar artery. We present an unusual case of unilateral INO after minor head injury in a patient with a small site of hemorrhage in the midline of the pontomesencephalic junction, confirmed by brain magnetic resonance imaging using susceptibility-weighted imaging.

Keywords: Minor head injury; Unilateral; Internuclear ophthalmoplegia

INTRODUCTION

The absence of adduction of the ipsilateral eye is the result of a medial longitudinal fasciculus (MLF) lesion, usually accompanied by nystagmus in the abducting eye, referred to as internuclear ophthalmoplegia (INO).

Multiple sclerosis is commonly associated with bilateral INO, while the cerebrovascular disease is commonly associated with unilateral INO in the elderly.[12,16] Bilateral or unilateral INO after minor head injury with no other neurological deficits is quite rare. The authors would like to report a case of unilateral INO immediately following minor head injury.

CASE REPORT

A 77-year-old male patient visited our emergency department complaining the diplopia and dizziness after falling backward. On examination, the patient was alert and oriented. He was noted to have an occipital scalp laceration. His pupils reacted normally to light and were symmetrical. On attempting right lateral gaze, the left eye failed to adduct and the right eye showed horizontal nystagmus (**FIGURE 1**). Visual acuity and fundoscopic examination

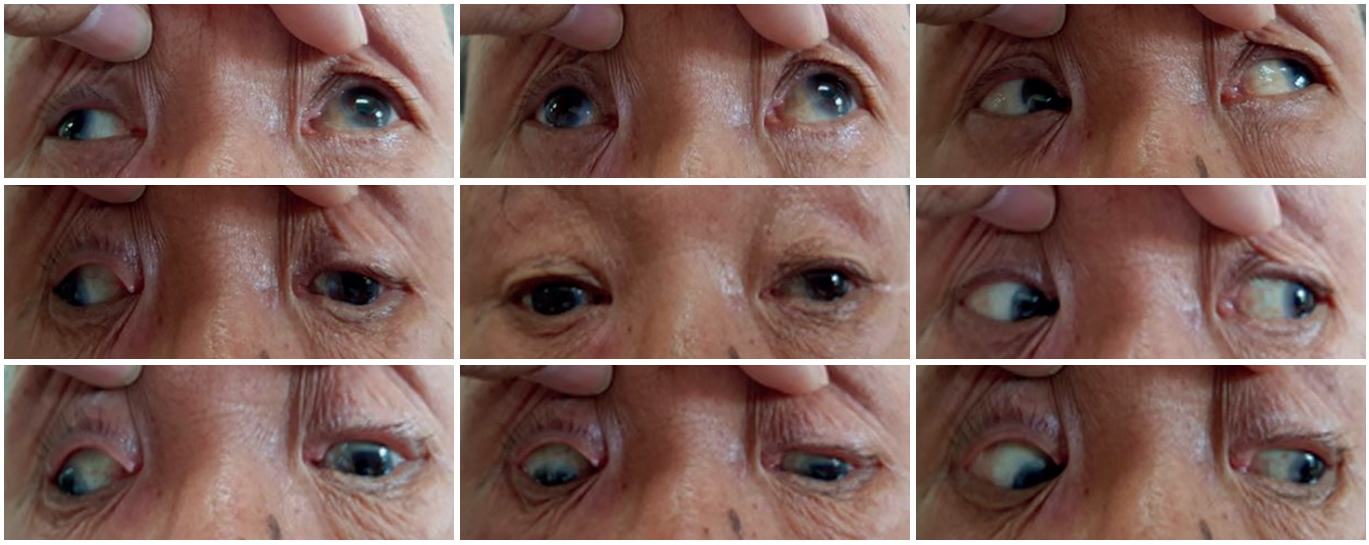

FIGURE 1. Initial 9 gaze positions of the patients. Medial gaze of left eye is limited.

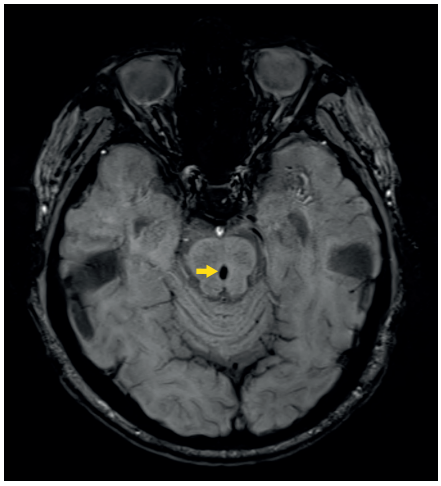

FIGURE 2. Susceptibility weighted image of the patient. Magnetic resonance imaging shows a tiny hemorrhage (yellow arrow) on the midline pontomesencephalic junction area.

were normal. Brain computed tomography (CT) revealed no evidence of intracranial lesions such as a contusion, hemorrhage, or edema. The susceptibility weighted imaging (SWI) of brain magnetic resonance imaging (MRI) showed a tiny hemorrhage on the midline pontomesencephalic junction (PMJ) area (yellow arrow in **FIGURE 2**). He did not receive any special treatment and was discharged 4 days later. When the outpatient visit was made one year after the accident, the symptoms were completely improved.

DISCUSSION

This report presents a case of post-traumatic unilateral INO caused by a very small hemorrhage on the midline of PMJ area confirmed by SWI of brain MRI. A lesion to the MLF may result in INO resulting in impairment of ocular adduction secondary to head injury. The INO is distinguished by the weakness of adduction ipsilateral to the lesion when the lesion is unilateral. There was a classic finding of unilateral INO in our patient. He had the left eye

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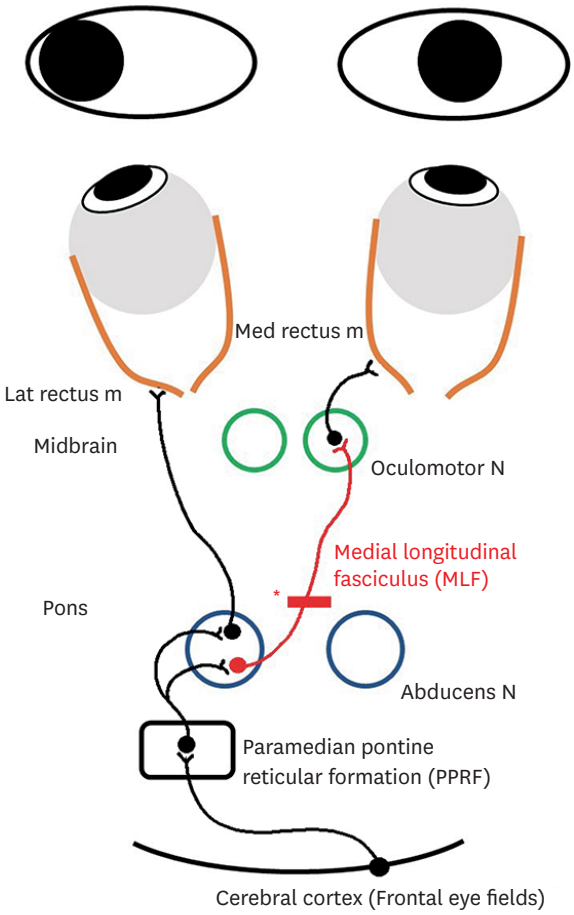

FIGURE 3. Schematic diagram of horizontal eye movements pathway.

failed to adduct and the right eye showed the horizontal nystagmus on the right lateral gaze.

INO is most commonly associated with demyelinating diseases such as multiple sclerosis or cerebrovascular diseases, then with tumors and infection, or other brain stem symptoms.[1,12,13,17] There are several distinct neuroanatomical pathways involved in conjugate gaze. In the brain stem, the sixth nerve nucleus receives supranuclear impulses that direct lateral saccades via the paramedian pontine reticular formation. There are motor neurons in the sixth nucleus that control the ipsilateral lateral rectus and interneurons that cross the midline of the brain stem to form the contralateral MLF. Interneurons in the MLF synapse with neurons in the contralateral medial rectus subnucleus of the oculomotor nucleus, resulting in contraction of the medial rectus (**FIGURE 3**).[4]

In moderate or severe head injury patients, there is a possibility of the development of INO without any other neurological deficits. But in cases of mild head trauma, isolated bilateral or unilateral INO, as in the patient described here, is a rare complication.

A number of mechanisms have been proposed to explain the pathogenesis of MLF damage in traumatic brain injury. As a result of a blow to the head, a pressure gradient through the skull is created, resulting in (1) shear force. A difference in density between cerebrospinal fluid and adjacent neural tissue exerts the most significant shear force. The aqueduct and fourth

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TABLE 1. Summary of isolated internuclear ophthalmoplegia related to head injury

Reference	Age	Sex	Laterality	Onset	Degree of recovery	Period of recovery
Chan (2001)[6]	32	M	Uni	Immediate	Full	6 months
Gray et al. (2001)[10]	14	M	Uni	1 hours	Partial	4 months
Hsu et al. (2001)[11]	34	M	Bi	Immediate	Full	3 months
Bonilha et al. (2002)[3]	36	M	Bi	Immediate	Partial	1 months
Walsh et al. (2003)[20]	29	M	Bi	Immediate	Partial	14 days
Verma and Misra (2004)[19]	40	F	Bi	Immediate	Full	6 months
Cerovski et al. (2006)[5]	40	F	Uni	Immediate	Full	5 months
Bamford and Singh-Ranger (2012)[2]	17	M	Uni	Immediate	Full	3 months
Liu et al. (2014)[15]	51	F	Uni	Immediate	Full	3 days
Chen et al. (2016)[7]	54	F	Uni	10 hours	Partial	1.5 months
Lee et al. (2016)[14]	43	M	Uni	Immediate	Full	3 months
Chon and Kim (2017)[8]	35	M	Uni	Immediate	Full	7 days
Thakkar et al. (2018)[18]	35	M	Bi	Immediate	Full	1 months
Present case	77	M	Uni	Immediate	Full	12 months

ventricle floor are very near the MLF. Thus, MLF is susceptible to these forces of shearing. And so, the ventral portion of the brain stem is tethered by small perforating branches of the basilar artery, the shear force makes more downward displacement of the dorsal portion of the brain stem than that of the ventral portion of the brain stem. These differences in the downward displacement between the ventral and dorsal portion of the brain stem can tear or stretch the axon fibers of the MLF which was located in the dorsal portion of the brain stem.

And also, the blood supply of the MLF is from the paramedian perforating branches of the basilar artery, which irrigate the brain stem ventral to dorsal, this finding makes MLF (2) a perfusion water shed zone. During the trauma, the shear forces within the brain stem could compromise or tear these perforating branches of the basilar artery, resulting in ischemia or hemorrhage of the MLF. So, these injury processes may lead to injury of the axon fibers of the MLF, or hemorrhage and infarction on the MLF.

Previously there were some case reports of INO caused by traumatic head injury. Up to the present case, 16 cases were reported after 2000. Multivariable analysis was performed using these cases. The factors used to analyze recovery were age, sex, and laterality. However, no statistically significant results were identified (**TABLE 1**). Cerovski et al.[5] reported a case of unilateral INO caused by an axonal traumatic lesion of the white matter in the MLF area after a minor head injury. Chan[6] reported a case of the infarction of right MLF presenting unilateral INO after minor head injury. And Walsh et al.,[7] also reported a case of the infarction of the MLF presenting bilateral INO after minor head injury. Lee et al.[14] reported a case of tiny hemorrhage on PMJ area presenting unilateral INO after minor head injury as like our case. All of the cases were recovered without any specific treatment. The time to recovery of MLF function ranges between a few days and less than one year after the injury (**TABLE 1**). Doslak et al.[9] reported on nerve plasticity through eye movement recording for INO recovery. This recovery can be facilitated by adaptive firing patterns that increase and then normalize saccadic pulse duration in response to the MLF lesion.

Because of the difficulty to find the MLF small lesions such as axonal injury, infarction, and hemorrhage after mild head trauma by the conventional brain CT, we recommend the brain MRI study including diffusion WI and SWI in case of clinically suspected INO after minor head injury.

https://doi.org/10.13004/kjnt.2022.18.e64

CONCLUSION

An INO caused by minor traumatic head injury is a rare complication. Brain MRI including SWI is a useful diagnostic tool for INO. But, it can be recovered with any specific treatment, self-limited condition. The physician should explain this to the patient well enough and follow up regularly.

REFERENCES

1. Amezcua L, Morrow MJ, Jirawuthiworavong GV. Multiple sclerosis: review of eye movement disorders and update of disease-modifying therapies. **Curr Opin Ophthalmol 26**:534-539, 2015
PUBMED | CROSSREF
2. Bamford R, Singh-Ranger G. Unilateral internuclear ophthalmoplegia after minor head injury. **West J Emerg Med 13**:123-124, 2012
PUBMED | CROSSREF
3. Bonilha L, Fernandes YB, Mattos JP, Borges WA, Borges G. Bilateral internuclear ophthalmoplegia and clivus fracture following head injury: case report. **Arq Neuropsiquiatr 60**:636-638, 2002
PUBMED | CROSSREF
4. Carla GA, Ana-Catalina RM, Jibran MN. How does a small area cause big syndromes? A case report of a patient with one-and-a-half syndrome and MRI review of the anatomical pathways involved in causing different pontine neuro-ophthalmological syndromes. **Am J Ophthalmol Case Rep 24**:101225, 2021
PUBMED | CROSSREF
5. Cerovski B, Vidović T, Papa J, Cerovski J, Bojić L. Minor head trauma and isolated unilateral internuclear ophthalmoplegia. **J Emerg Med 31**:165-167, 2006
PUBMED | CROSSREF
6. Chan JW. Isolated unilateral post-traumatic internuclear ophthalmoplegia. **J Neuroophthalmol 21**:212-213, 2001
PUBMED | CROSSREF
7. Chen KT, Lin TK, Hsieh TC. Isolated internuclear ophthalmoplegia after massive supratentorial epidural hematoma: a case report and review of the literature. **World Neurosurg 100**:712.e5-712.e13, 2017
PUBMED | CROSSREF
8. Chon J, Kim M. Bilateral internuclear ophthalmoplegia following head trauma. **Indian J Ophthalmol 65**:246-247, 2017
PUBMED | CROSSREF
9. Doslak MJ, Kline LB, Dell'Osso LF, Daroff RB. Internuclear ophthalmoplegia: recovery and plasticity. **Invest Ophthalmol Vis Sci 19**:1506-1511, 1980
PUBMED
10. Gray OM, Forbes RB, Morrow JI. Primary isolated brainstem injury producing internuclear ophthalmoplegia. **Br J Neurosurg 15**:432-434, 2001
PUBMED | CROSSREF
11. Hsu HC, Chen HJ, Lu K, Liang CL. Reversible bilateral internuclear ophthalmoplegia following head injury. **Acta Ophthalmol Scand 79**:57-59, 2001
PUBMED | CROSSREF
12. Keane JR. Internuclear ophthalmoplegia: unusual causes in 114 of 410 patients. **Arch Neurol 62**:714-717, 2005
PUBMED | CROSSREF
13. Kochar PS, Kumar Y, Sharma P, Kumar V, Gupta N, Goyal P. Isolated medial longitudinal fasciculus syndrome: review of imaging, anatomy, pathophysiology and differential diagnosis. **Neuroradiol J 31**:95-99, 2018
PUBMED | CROSSREF
14. Lee SH, Nam TK, Park YS, Kwon JT. A case of traumatic unilateral internuclear ophthalmoplegia: clinical significance of susceptibility-weighted imaging. **Korean J Neurotrauma 12**:140-143, 2016
PUBMED | CROSSREF
15. Liu WC, Hsiang CW, Hsu CH. An unusual gaze after head injury. **Emerg Med J 31**:1028-1028, 2014
PUBMED | CROSSREF
16. Nij Bijvank JA, van Rijn LJ, Balk LJ, Tan HS, Uitdehaag BM, Petzold A. Diagnosing and quantifying a common deficit in multiple sclerosis: Internuclear ophthalmoplegia. **Neurology 92**:e2299-e2308, 2019
PUBMED | CROSSREF

https://doi.org/10.13004/kjnt.2022.18.e64

17. Shinoda K, Matsushita T, Furuta K, Isobe N, Yonekawa T, Ohyagi Y, et al. Wall-eyed bilateral internuclear ophthalmoplegia (WEBINO) syndrome in a patient with neuromyelitis optica spectrum disorder and anti-aquaporin-4 antibody. **Mult Scler 17**:885-887, 2011
PUBMED | CROSSREF

18. Thakkar HH, Agrawal A, Trivedi S, Singh K. Bilateral medial rectus palsy due to midbrain infarction following concussion head injury. **Indian J Ophthalmol 66**:166-167, 2018
PUBMED | CROSSREF

19. Verma A, Misra S. Bilateral internuclear ophthalmoplegia following head injury. **J Assoc Physicians India 52**:990-991, 2004

20. Walsh WP, Hafner JW Jr, Kattah JC. Bilateral internuclear ophthalmoplegia following minor head trauma. **J Emerg Med 24**:19-22, 2003
PUBMED | CROSSREF

https://doi.org/10.13004/kjnt.2022.18.e64