

# Abnormal Eye Movement in Medullary Lesion



최 광 동

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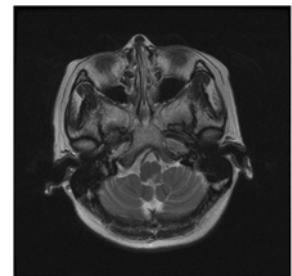
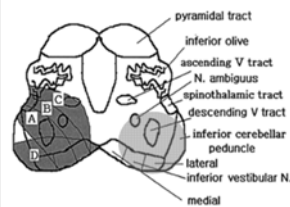
## Medullary syndrome

- Lateral medullary syndrome
- Medial medullary syndrome
- Dorsal medullary syndrome ??

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## Lateral medullary infarction (LMI)

- Vestibular nucleus
- Sympathetic tract
- Inferior cerebellar peduncle



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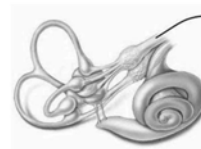
## Vestibular nucleus

- Horizontal neural integrator (horizontal GEN)

Vestibular nucleus

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## Vestibular nucleus



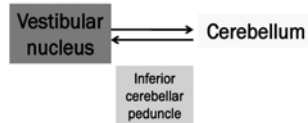
Extraocular motor neurons (III, IV, VI)

- Spontaneous nystagmus
- Ocular-tilt reaction (OTR)

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## Vestibular nucleus

➤ Ipsilesional horizontal head-shaking nystagmus



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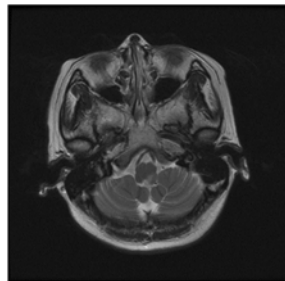
## Inverse Ptosis in Horner Syndrome : Sunrising Sign



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## Spontaneous nystagmus

SN I  
SN II  
SN III

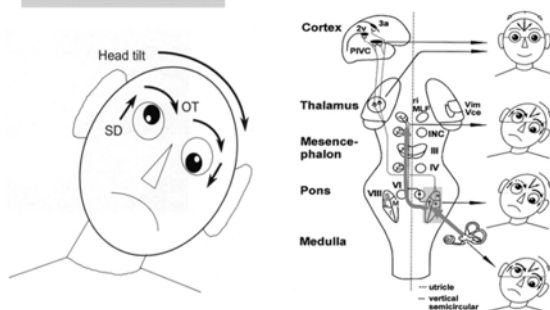


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- Spontaneous nystagmus (vestibular nucleus)
  - : ipsilesional mixed horizontal-torsional N (rostral lesion)
  - : contralesional mixed horizontal-torsional N (caudal lesion)
  - : vertical component – usually upbeat
  - : pure torsional nystagmus
- Horizontal gaze-evoked nystagmus
  - : medial vestibular nucleus (MVN)

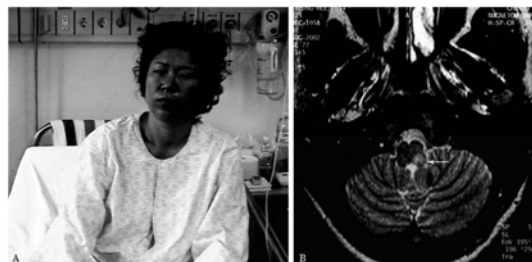
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## Ipsilesional OTR



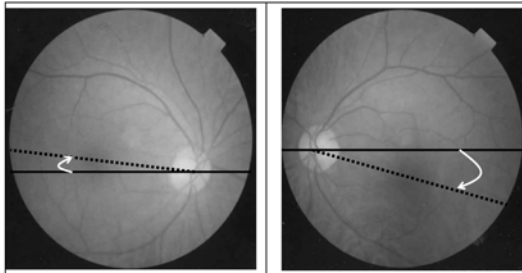
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## Ipsilesional OTR



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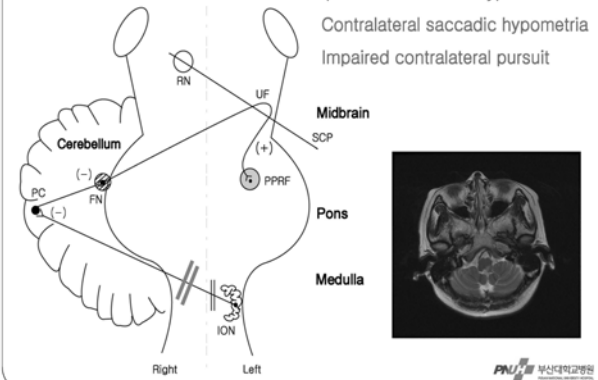
### Ipsilesional OTR



SW: OD: -6.72, OS: -7.56, OU: -6.98

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### Ocular ipsipulsion



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### Ipsilesional head-shaking nystagmus



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### ARTICLES

## Head-shaking nystagmus in lateral medullary infarction

Patterns and possible mechanisms

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S.-Y. Oh, MD  
S.-H. Park, MD  
J.-H. Kim, MD  
J.-W. Koo, MD  
J.S. Kim, MD, PhD

### OBJECT

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**ABSTRACT Objective:** Horizontal head shaking at 2 to 3 Hz can induce nystagmus in patients with central as well as in patients with peripheral vestibulopathy. However, the characteristics and diagnostic value of this post-head-shaking nystagmus (HSN) have not been studied systematically in central vestibulopathy, and little is known of the mechanisms involved. **Methods:** We analyzed spontaneous HSN and the effects of baclofen, a GABA<sub>A</sub> agonist, in 16 patients with acute lateral medullary infarction. **Results:** These patients showed several characteristics of HSN unlike those observed in peripheral vestibulopathy. HSN was observed in 14 of 16 patients (87.5%), and in all cases, the horizontal component beats toward the lesion side, i.e., was ipsilesional. Even in the eight patients with contralateral spontaneous horizontal nystagmus, the HSN was opposite to the spontaneous nystagmus. Three patients showed unusually strong HSN with a maximum slow-phase velocity greater than 60 degrees/second. Visual fixation markedly suppressed HSN and baclofen reduced HSN. In most of the patients, MRI showed infarctions in the caudal or middle portion of the medulla and spared the rostral portion. **Conclusions:** We propose that head-shaking nystagmus in lateral medullary infarction is due to unilaterally impaired nodulo-ocular inhibition of the velocity storage. This proposal is consistent with the results of neuroanatomic studies that demonstrate that Purkinje cells controlling velocity storage in the nodulus and ventral uvula project to the caudal or middle portion of the vestibular nuclei, whereas those subserving visual-vestibular interactions in the flocculus project to the more rostral portion. **NEUROLOGY** 2007;68:1337-1344

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### BASIC AND CLINICAL ASPECTS OF VERTIGO AND DIZZINESS

## Head-Shaking Nystagmus in Central Vestibulopathies

Kwang-Dong Choi<sup>a,b</sup> and Ji Soo Kim<sup>a</sup>

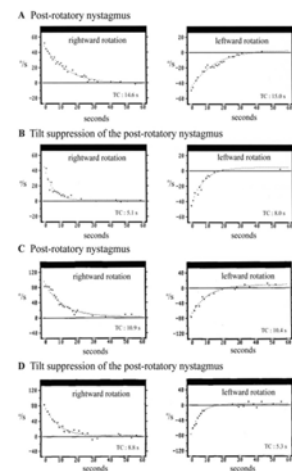
<sup>a</sup>Department of Neurology, Seoul National University Bundang Hospital, Seoul National University College of Medicine, Seoul, Korea

<sup>b</sup>Department of Neurology, Pusan National University School of Medicine and Medical Research Institute, Pusan National University, Pusan, Korea

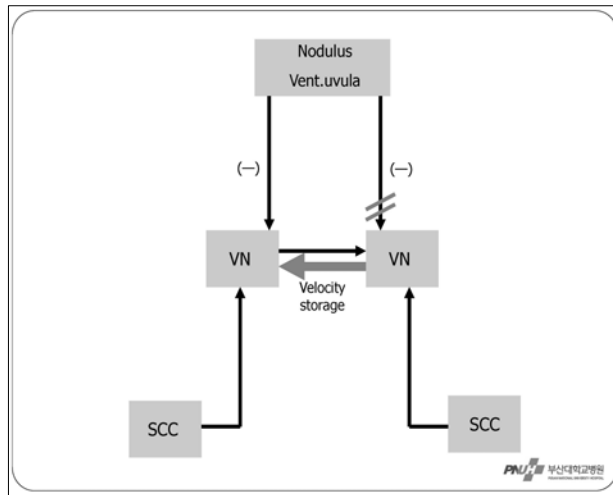
Mechanisms of head-shaking nystagmus (HSN) require further exploration in central vestibular disorders. To determine whether impaired uvulonodular inhibition over the velocity storage of the vestibulo-ocular reflex (VOR) is the mechanism of ipsilesional HSN in lateral medullary infarction (LMI), 17 patients with ipsilesional HSN and LMI underwent measurements of the VOR gains during low-frequency sinusoidal harmonic accelerations, and the time constants (TC) of the VOR and tilt suppression of the post-rotatory nystagmus during step-velocity rotation. Compared with normal controls, the patients showed increased VOR gains without difference between ipsi- and contralateral rotations, while the VOR TCs were decreased without directional asymmetry during step-velocity rotation. In contrast, the patients showed impaired tilt suppression of the postrotatory nystagmus, and the impairment of tilt suppression was more severe after contralateral than ipsilesional rotation. The asymmetric tilt suppression may generate ipsilesional HSN by increasing contralateral velocity storage during head shaking, and may be ascribed to disruption of ipsilesional nodulo-uvular inhibition of the velocity storage mechanism.

**Key words:** head-shaking nystagmus; lateral medullary infarction; vestibulo-ocular reflex; time constants; tilt suppression; nodulus; cerebellum

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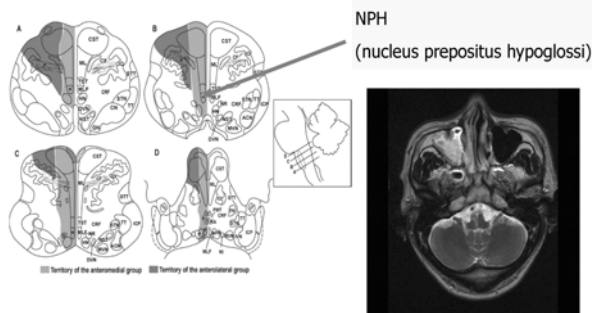
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## Ophthalmological findings in LMI

- Horner's syndrome
- Spontaneous nystagmus (vestibular nucleus)
  - : contralesional mixed horizontal-torsional N (rostral lesion)
  - : ipsilesional mixed horizontal-torsional N (caudal lesion)
  - : vertical component – usually upbeat
  - : pure torsional nystagmus
- Horizontal gaze-evoked nystagmus
  - : medial vestibular nucleus (MVN)
- Ocular ipsipulsion
- Ipsilesional OTR
- Ipsilesional head-shaking nystagmus

## Medial medullary infarction (MMI)



Kim, J. S. et al. Neurology 2005;65:1294-1298

NEUROLOGY

AMERICAN ACADEMY OF  
NEUROLOGY

### • NPH lesioning

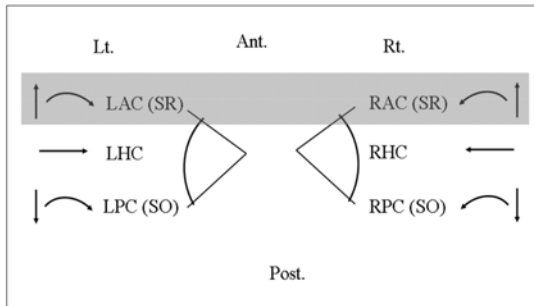
- : ipsilesional mixed horizontal-torsional nystagmus
- : horizontal GEN (ipsi-gaze >> contra-gaze)
- : vertical GEN (NPH connection to INC)



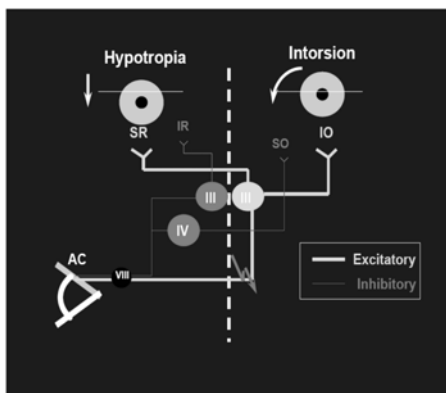
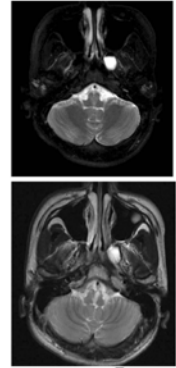
## Upbeat nystagmus in MMI



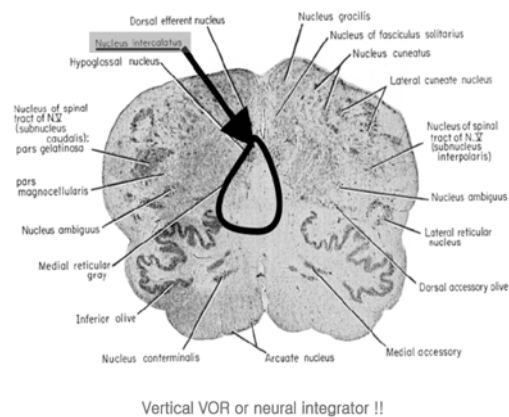
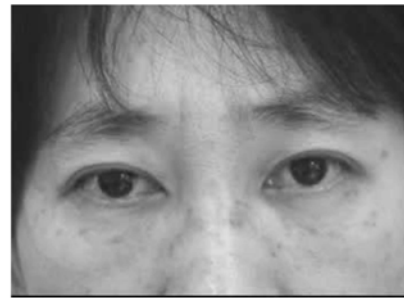
- Spontaneous nystagmus
  - : upbeat nystagmus  
(disruption of bilateral anterior canal pathways or nucleus intercalatus/Roller)



### Hemi-seesaw nystagmus in MMI



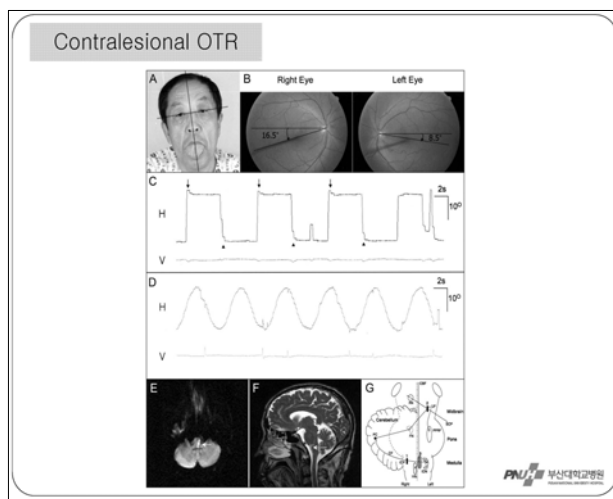
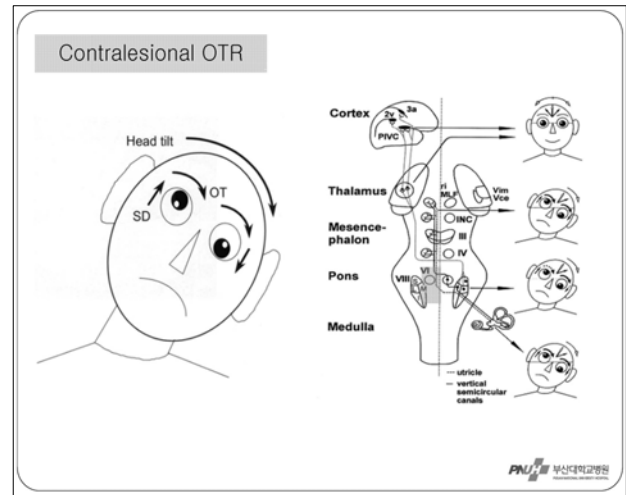
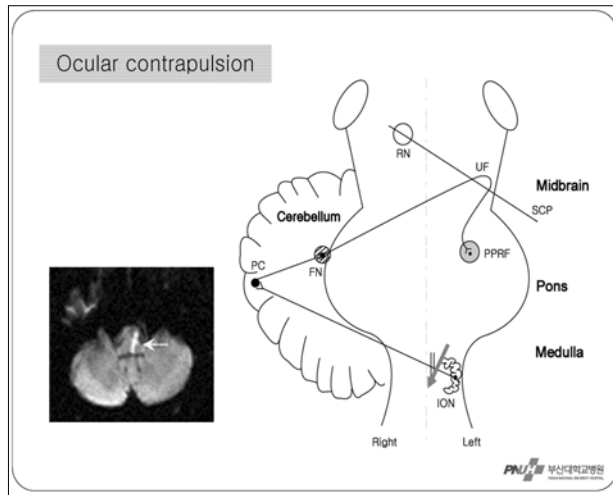
### Upbeat nystagmus in MMI



Vertical VOR or neural integrator !!

- Spontaneous nystagmus
  - : ipsilesional mixed horizontal-torsional nystagmus (nucleus prepositus hypoglossus: NPH)
  - : upbeat nystagmus (bilateral AC or nucleus intercalatus, Roller)
  - : hemi-seesaw nystagmus

- Gaze-evoked nystagmus
  - : horizontal GEN (ipsi-gaze >> contra-gaze)
    - nucleus prepositus hypoglossus (NPH)
  - : vertical GEN (NPH connection to INC)



**Medial medullary infarction: Abnormal ocular motor findings**

**Abstract**—In 20 consecutive patients with isolated medial medullary infarction, abnormal ocular motor findings included nystagmus (n = 8), ocular contrapulsion (n = 5), and contralesional ocular tilt reaction (n = 2). The nystagmus was ipsilesional (n = 4), gaze-evoked (n = 5), upbeat (n = 4), and hemiseesaw (n = 1). The ocular motor abnormalities may be explained by involvements of the nucleus prepositus hypoglossi, medial longitudinal fasciculus or efferent fibers from the vestibular nuclei, climbing fibers, and cells of the paramedian tracts.

NEUROLOGY 2005;65:1294–1298

J. Soo Kim, MD; K.-D. Choi, MD; S.-Y. Oh, MD; S.-H. Park, MD; M.-K. Han, MD; B.-W. Yoon, MD; and J.-K. Roh, MD

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**Ophthalmological findings in MMI**

- Spontaneous nystagmus
  - : ipsilesional mixed horizontal-torsional nystagmus (nucleus prepositus hypoglossus: NPH)
  - : upbeat nystagmus (bilateral AC or nucleus intercalatus/Roller)
  - : hemi-seesaw nystagmus
- Gaze-evoked nystagmus
  - : horizontal GEN (ipsi-gaze >> contra-gaze)
    - nucleus prepositus hypoglossus (NPH)
  - : vertical GEN (NPH, MVN)
- Ocular contrapulsion
- Contralesional OTR

Abnormal eye movement in medullary syndrome		
	Lateral medullary syndrome	Medial medullary syndrome
<b>Spontaneous nystagmus</b>	Ipsilesional or contralateral mixed horizontal-torsional N Pure torsional	Ipsilesional mixed horizontal-torsional N Upbeat N Hemi-seesaw N
<b>Gazed-evoked nystagmus</b>	Horizontal	Horizontal (ipsi >> contra) Vertical
<b>Ocular lateropulsion</b>	Ipsilesional	Contralateral
<b>Ocular tilt-reaction</b>	Ipsilesional	Contralateral