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Research Paper

Static and dynamic visual vertical perception in subjects with migraine and vestibular migraine

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Abstract *Objective:* To measure the static visual vertical and the effect of visual rotation on the perception of visual vertical in migraine and vestibular migraine subjects. By so doing, we may better understand the vestibular contribution to the pathophysiology of migraine, as well as the capacity for visual compensation.
Methods: The perception of visual vertical in the presence of static and dynamic visual cues was prospectively studied in 10 subjects with migraine, 6 subjects with vestibular migraines, and 10 controls. Subjects used a dial to rotate a fluorescent green line to the vertical position. Static visual vertical (SVV) was measured with a black background, as well as with a static random-dot visual pattern. This pattern was then rotated at various velocities to measure dynamic visual vertical (DVV).
Results: Migraine subjects had greater deviation from true vertical than controls in SVV ($P < 0.05$). The DVV in migraine subjects was greater than controls when rotated in the counterclockwise at $-5°/s$ ($P < 0.01$), $-20°/s$ ($P < 0.01$), and $-80°/s$ ($P < 0.01$), but not when the line was rotated clockwise. Vestibular migraine subjects did not deviate significantly from controls in SVV ($P < 0.37$, $P < 0.22$), but did show greater deviation in the DVV tasks at -80 and $-20°/s$ ($P < 0.05$, $P < 0.03$). Migraine and vestibular migraine subjects demonstrated a wider range of vertical deviance when compared to controls ($P < 0.02$).

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Conclusions: This study demonstrates a significant deviation of the perceived static as well as dynamic visual vertical in migraine subjects. Moving stimuli may have a greater influence on migraine and vestibular migraine subjects, which suggests an underlying sensory integration disorder.

Introduction

Visual vertical is a gravitational reference that allows the brain to control body orientation and stabilization in space.[1] This reference is developed by the brain through integration of vestibular, visual, and somatosensory cues.[2–4] Static visual vertical (SVV) is the perceived visual vertical without rotation of the visual background, and is a sensitive and widely used tool to detect an imbalance in otolith function.[5,6] Dynamic visual vertical (DVV) is the change in perceived vertical upon rotation of a visual background around the line of sight.[1,7]

Migraineurs often suffer from vestibular symptoms, including vertigo and the feeling of tilting during migraine episodes.[8–12] Despite these vestibular symptoms, only a few studies have the effects of migraine on SVV, with one study showing subclinical deviation of the SVV, and another showing no effect.[13,14] While many studies have looked at the visual contribution to migraines, fewer studies have looked at the potential vestibular pathology and to our knowledge none have looked at subjective visual vertical with a dynamic (rotating) visual background.

A decreased perceptual roll-tilt threshold in vestibular migraineurs in comparison to controls has been demonstrated, suggesting abnormally enhanced perception.[15] Although this is an interesting effect, it is not clear if it is limited to vestibular perception or if it can be more broadly applied to other sensory stimuli.

By using subjective visual vertical for studying otolith function, our study aims to further develop the vestibular contribution to migraine pathophysiology. The dynamic visual vertical is a multisensory integration task which allows us to better understand visual adaptation in vestibular deficits. We hypothesized that subjects with migraine or vestibular migraine will have greater deviations in their SVV and DVV, suggesting both a vestibular component to the pathophysiology, as well as limited capacity for visual compensation.

Materials and methods

Participants

Ten subjects with migraine, and six subjects with vestibular migraine were recruited, as well as 10 controls. All migraineurs met International Headache Society criteria for migraine.[16] All vestibular migraine subjects met clinical criteria for diagnosis.[17] Of the migraineurs, 8 had migraine with aura, and 8 had migraine without aura. Subjects were excluded if currently on prophylactic medication for migraine. All migraineurs were asymptomatic during their testing.

All subjects underwent general screening for history of dizziness and vertigo, as well as hearing and vision problems. History of neurologic and rheumatic disease was also explored. Severity of migraine was assessed in all subjects using the migraine severity scale (MIGSEV).[18] Additional demographic information is available in Table 1.

Tests and procedures

Subjects were seated in front of an 11.75 × 21 inch computer screen which displayed a 4 mm fluorescent green

Table 1 Population data. Standard deviation indicated in parentheses.

Demographic		Control	Typical migraine	Vestibular migraine
Number of subjects		10	10	6
Age		27 (15)	33 (13)	30 (5)
Gender				
	Male	6	2	0
	Female	4	8	6
Race				
	White	7	9	4
	Asian	3	1	1
	Black	0	0	1
Handedness				
	Right	10	8	5
	Left	0	1	1
	Ambidextrous	0	1	
Migraine type				
	Migraine with aura		6	2
	Migraine without aura		4	4
MIDAS score		0.875 (2.1)	9 (10.5)	32 (29)
Midas classification				
	Little or no disability (0–5)		0	
	Mild disability (6–10)		8	3
	Moderate disability (11–20)			
	Severe disability (>20)		2	3