treatment and plasmapheresis are effective in preserving sensory nerve potentials and motor function.

JAU-SHIN LOU
ROBERT SNYDER
ROBERT C GRIGGS
Department of Neurology, University of Rochester Medical Center, Rochester, NY, USA

Correspondence to: Dr Jau-Shin Lou, University of Rochester Medical Center, Department of Neurology, Box 673, 601 Elmwood Avenue, Rochester, NY 14642, USA.

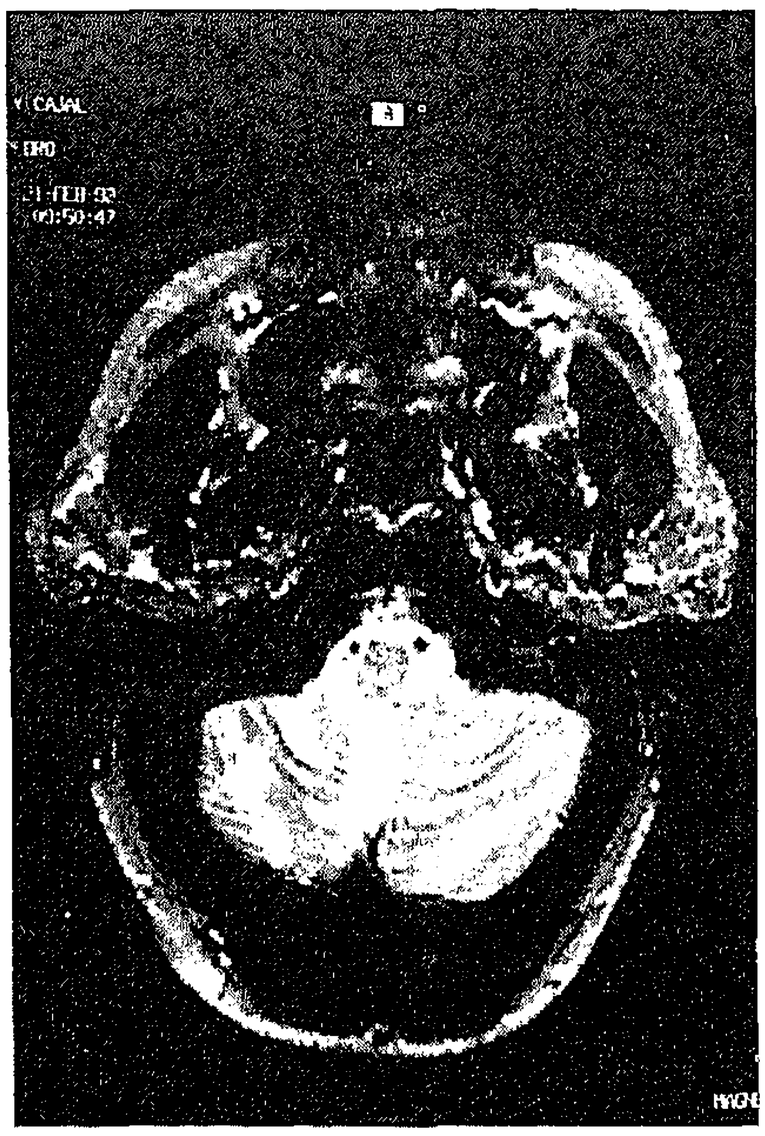
1 Skinjedal O, Stokke O, Refsum S. Phytanic acid storage disease. In: Dyck PJ, Thomas PK, Griffin JW, Low PA, Poduslo JF, eds. *Peripheral neuropathy*. 3rd ed. Philadelphia: WB Saunders Company, 1993:1149–60.
2 Thomas PK. Classification and electrodiagnosis of hereditary neuropathies. In: Brown WF, Bolton CF, eds. *Clinical electromyography*. 2nd ed. Boston: Butterworth-Heinemann, 1993: 391–425.
3 Penovich PE, Hollander J, Nusbacher JA, Griggs RC, MacPherson J. Note on plasma exchange therapy in Refsum's disease. *Adv Neurol* 1978;21:151–3.
4 Pabico RC, Gruebel BJ, McKenna BA, Griggs RC, Hollander J, Nusbacher J, Panner BJ. Renal involvement in Refsum's disease. *Am J Med* 1981;70:1136–43.
5 Ogawa-Goto K, Funamoto N, Abe T, Nagashima K. Different ceramide compositions of gangliosides between human motor and sensory nerves. *J Neurochem* 1990;55: 1486–93.

Contraversive visual tilt illusion associated with a cerebellar infarction

Visual tilt illusion consists of an abnormal perception of the environment, which seems to be rotated at a variable angle without any change in perception of the other characteristics of the objects. It is sometimes associated with other postural and ocular tilt effects. It can be secondary to disturbances in the peripheral or central vestibular pathways.[1 2] Previous reports suggest that cerebellar injuries could also cause it,[2] but this has not been documented before. We report a case of visual tilt illusion probably associated with an isolated cerebellar lesion, studied with CT and MRI.

A 56 year old man with hypertension and hypercholesterolaemia had a sudden attack of continuous vertigo not related to cephalic movements, with nausea and vomiting and a deviation to the left while walking. When it disappeared, 48 hours later, he complained that he saw objects as if they were tilted to his right by 30° and they should be rotated anticlockwise—that is, to his left—so as to be perceived as vertical. He had a slight head and body tilt to his left that worsened when he was asked to close his eyes and stand upright. There was no skew deviation or other ocular motor disorders. Fundal photographs were not taken, so that ocular torsion could not be assessed. There were no other alterations on neurological examination. Two weeks later the patient was asymptomatic. Brain CT and MRI showed a right hemispheric cerebellar lesion, suggesting an ischaemic infarction (figure). No brainstem or cortical alterations were found.

Visual tilt illusion has been described in unilateral peripheral vestibular lesions; in brainstem injuries, typically in the Wallenberg syndrome, in other medullary and mesencephalic lesions, and in thalamic and parietoinsular cortex disorders.[1 2] The most frequent conditions associated with visual tilt illusion are vascular lesions.[1] As far as we know, there are no reports on documented isolated cerebellar injuries associated with the illusion.



Axial T2 weighted (SE 2000/80) MRI shows an increased signal intensity in the right hemispheric cerebellar region without mass effect, corresponding to an ischaemic infarction in the territory of the posteroinferior cerebellar artery.

Physiologically, the vestibular pathways make contact with the ocular motor system, the spinal cord, and the vestibular cortex, contributing to the stabilisation of posture and perception of verticality and self motion.[3–5] The tonic bilateral vestibular input builds up the actual central vestibular tone in the three major planes: horizontal or "yaw", sagittal or "pitch", and frontal or "roll".[2 4 5] It seems that central pathways that mediate vestibular function in either of the three planes travel independently of each other, so that a specific lesion could cause a disorder restricted to one of them.[2 4] The vestibular tone in the frontal or "roll" plane allows a correct perceptual, ocular, and postural alignment to the "gravitational vertical;" an imbalance in this tone causes a lateral tilt with alteration in perception of verticality, head and body posture, misalignment of the visual axes, or ocular torsion.[2–5] Patients perceive the surroundings and their body as if they were tilted in the opposite direction to what the CNS erroneously computes as being vertical and try to adjust the visual objects and posture to it. Dieterich and Brandt showed that an alteration in the perceived verticality is not just the sensory consequence of the rotation of the eyes, as they can appear separately and are not proportional in degree.[1] Furthermore, it is possible that not all the effects of tilt occur in one patient, and the perceptual disorder itself is the most sensitive sign of a vestibular tone imbalance in the frontal plane.[1 5] Brainstem structures that mediate the vestibular tone in the "roll" plane include the vestibular nuclei and the intersticial nucleus of Cajal—perhaps the most rostral structure related to the control of vertical and torsional head and eye position. Both are connected by the medial longitudinal fasciculus, which crosses the midline in the pons.[2 4] Visual vertical tilt is, then, ipsiversive to peripheral or pontomedullary lesions and contraversive to pontomesencephalic lesions and, in both cases, is usually associated with other tilt effects; in most rostral lesions it may be either ipsiversive or contraversive and is usually isolated.[2 5] The role of the vestibular cerebellar structures with respect to the control of subjective verticality is not well known at the moment.[2]

Our patient's clinical findings suggest that he had an inclination of the internal representation of the gravitational vector to his left and he tried to adjust both visual objects and posture to what he perceived as being vertical. It would have been interesting to assess whether there was ocular torsion, to define his clinical setting more exactly, but it makes no difference to interpretation as ocular torsion can be associated or not with perceptual or other tilt effects.[1] Our patient showed a right hemispheric cerebellar ischaemic lesion, in a territory dependent on the posteroinferior cerebellar artery (PICA), with no mass effect and no brainstem or other alterations on MRI. His perceptual and postural tilt was contraversive to the lesion. It is possible that an additional subtle medullary lesion in the distribution of the PICA, not evident with clinical and imaging studies, produced the tilt effects in this case, because the major infratentorial arteries supply both brainstem and cerebellum and it is very difficult to differentiate the effects of cerebellar and brainstem lesions.[2] But the tilt should then be ipsiversive, not contraversive, to the hypothetical lesion. Therefore it is not likely that an associated medullary ischaemia could cause the tilt effects in our patient. A mesencephalic injury could cause this clinical picture but there were no other upper brainstem symptoms and MRI was normal at this level. A supratentorial disorder is unlikely because there were no MRI alterations and there were associated postural tilt effects. In this patient, we think that cerebellar dysfunction could be responsible for the tilt effects.

The present report confirms a previously hypothesised role for the cerebellar structures in the control of perception of verticality,[2] and may contribute to a better knowledge of the pathophysiology and the topographic diagnosis of the central vestibular syndromes.

M BARON
JM GOBERNADO
J MASJUAN
M LOUSA
Servicio de Neurología, Hospital Ramón y Cajal, Universidad de Alcalá de Henares, Madrid, España

Correspondence to: Dr M Barón, Servicio de Neurología, Hospital Ramón y Cajal, Ctra de Colenar, Km 9.100, 28034 Madrid, Spain.

1 Dieterich M, Brandt T. Ocular torsion and tilt of subjective visual vertical are sensitive brainstem signs. *Ann Neurol* 1993;33:292–9.
2 Brandt T, Dieterich M. Vestibular syndromes in the roll plane: topographic diagnosis from brainstem to cortex. *Ann Neurol* 1994;36: 337–47.
3 Rudge P, Bronstein AM. Investigations of disorders of balance. *J Neurol Neurosurg Psychiatry* 1995;59:568–78.
4 Leigh RJ, Brandt TH. A re-evaluation of the vestibulo-ocular reflex: new ideas of its purpose, properties, neural substrate, and disorders. *Neurology* 1993;43:1288–95.
5 Dieterich M, Brandt T. Vestibulo-ocular reflex. *Curr Opin Neurol* 1995;8:83–8.

Low striatal D2 receptor binding as assessed by [^{123}I]IBZM SPECT in patients with writer's cramp

Writer's cramp is a form of idiopathic focal task specific dystonia. In accord with other studies on idiopathic and symptomatic dystonia, Tempel and Perlmutter suggested the presence of an abnormal striatothalamocortical drive in writer's cramp.[1] In view of the

Demographic data, [^{123}I] IBZM SPECT, and bradykinesia pegboard test in patients with writer's cramp and controls

	Age (y)	*Duration of disease (y)*	*[^{123}I] IBZM SPECT*		*Pegboard (s)*	
			R brain	*L brain*	*R hand*	*L hand*
Writer's cramp (n = 10)†	51·6 (9·0)	8·6 (3·9)	1·56 (0·10)***	1·53 (0·09)***	9·7 (1·1)	9·8 (0·9)
Controls (n = 12)	51·8 (11·0)	—	1·88 (0·19)	1·87 (0·15)	—	—
Controls (n = 46)	55·8 (9·5)	—	—	—	9·8 (1·5)	10·0 (1·4)

Values in parentheses are SD.
***P < 0·0001 *v* controls.
†Four patients had simple writer's cramp and six had dystonic writer's cramp.

possible involvement of dopaminergic striatal receptors in dystonia, we measured the availability of striatal D2 receptors in patients with writer's cramp using [^{123}I]IBZM SPECT.

Ten consecutive right handed patients (eight male and two female) were classified into four with simple and six with dystonic writer's cramp depending on whether or not the symptoms appeared only during writing. None of the patients had been treated with neuroleptic, dopaminergic, or anticholinergic drugs or botulinum toxin. Hypokinesia, rigidity, and resting tremor were absent in all patients. Bradykinesia of the hands was assessed with a pegboard test, measuring the time (s) required to invert eight pegs. Pegboard performance of patients was compared with that of 46 age matched controls. Results from [^{123}I]IBZM SPECT were compared with 12 other age matched controls from an earlier study.[2]

A brain dedicated SPECT system, the Strichman Medical Equipment 810X, was used. Two hours after intravenous injection of approximately 185 MBq [^{123}I]IBZM (Cygne BV, Technical University, Eindhoven), tomographic SPECT studies were performed. A maximum of 12 slices was made, starting at the orbitomeatal line and proceeding parallel to it (300 s/slice; interslice distance 10 mm). For analysis of specific striatal [^{123}I]IBZM binding, two slices with the highest striatal activity were summated and a template with fixed regions of interest for the striatum and occipital cortex was placed bilaterally on the summated image.[2] The ratio of the striatal binding divided by the occipital binding quantifies specific binding.

The mean ages (table) did not differ among the three groups (*t* tests). Left and right [^{123}I]IBZM striatal : occipital ratios were significantly lower in patients than in controls (*t* test, P < 0·000). There was no asymmetry between [^{123}I]IBZM ratios for the hemispheres in patients or controls (repeated measures multivariate analysis of variance (MANOVA) tests involving side, group, and group by side: P > 0·05). The pegboard test did not differ between patients with writer's cramp and controls in either hand (*t* tests), showing that the patients with writer's cramp did not have bradykinesia. There was no correlation between age or duration of disease and [^{123}I]IBZM ratios (Pearson's correlation coefficients). None of the variables differed between patients with simple and dystonic writer's cramp.

Our results suggest that the striatal dopaminergic system is involved in writer's cramp given that patients with writer's cramp have a significantly lower level of striatal [^{123}I]IBZM binding than controls. Unfortunately, lack of an accurate measure of the severity of writer's cramp itself prevented us from studying the relation between severity of dystonia and [^{123}I]IBZM. We did not find a correlation between [^{123}I]IBZM ratios and duration of disease or age. This probably means that the decline in striatal D2 receptors is not linearly progressive but remains stable over many years, which accords with our clinical impression. However, because the preclinical [^{123}I]IBZM ratios of the individual patients were not known, it is hazardous to assess rates of decline in a small cross sectional sample.

The results raise some questions. Firstly, there was bilateral reduction of available striatal D2 receptors, whereas the symptoms were unilateral and there was no asymmetry between the hemispheres. Bilateral abnormalities in writer's cramp, have, however, also been found by others.[1,3] This bilaterality probably only means that the abnormalities found are related to particular motor dysfunctions which pass undetected if not properly challenged, as shown by the fact that many patients develop writer's cramp on the left side, if they change to writing with the left hand. Accordingly, it is also not uncommon to find involvement of the left, or fingering hand, in musicians playing keyboards, guitars, or other stringed instruments.[3]

A second question is why the reduced availability of D2 receptors was not accompanied by parkinsonism in our patients. According to well known models of basal ganglia function, overactivity of the indirect striatopallidal pathway is usually associated with parkinsonism. Because D2 receptor stimulation inhibits the indirect pathway, by contrast with the D1 receptor driven direct pathway,[4] the decreased striatal D2 receptor binding in writer's cramp indicates disinhibition of the indirect pathway which might be expected to be accompanied by parkinsonism. In line with this view, we found the mean [^{123}I]IBZM ratio to be 1·43 (SD 0·16) in patients with definite hypokinetic-rigid symptoms due to multiple system atrophy or progressive supranuclear palsy,[2] which is in the same range as the values obtained in most of the present patients with writer's cramp (1·27–1·59).

Therefore, our finding is probably better explained by loss of D2 receptors on cholinergic striatal interneurons rather than D2 receptors on striatal spiny output neurons. The number of D2 receptors on striatal cholinergic interneurons is sufficient to account for the decreased density of D2 receptors in our patients.[5] Furthermore, striatal cholinergic interneurons are highly represented in the sensorimotor part of the striatum and are predominantly innervated by fibres from the thalamus suggesting a feed forward modulation from thalamus to striatum.[6] A dysfunction of such thalamostriatal sensorimotor function—caused by increased activity of striatal cholinergic interneurons resulting from disinhibition due to D2 receptor loss—fits the suggestion that central sensory processing in dystonia is impaired.[7] Our hypothesis that writer's cramp dystonia could be related to an increased activity of striatal cholinergic interneurons is also consistent with the increased density of striatal cholinergic interneurons in dystonia after perinatal asphyxial injury,[8] and with the well known efficacy of anticholinergic therapy in dystonia.

CA HORSTINK
P PRAAMSTRA
MWIM HORSTINK
Department of Neurology
HJC BERGER
Department of Medical Psychology
J BOOIJ
EA VAN ROYEN
Academic Medical Centre, Amsterdam, The Netherlands, Department of Nuclear Medicine, University Hospital Nijmegen, The Netherlands

Correspondence to: Dr MWIM Horstink, Department of Neurology, University Hospital Nijmegen, PO Box 9101, 6500 HB Nijmegen, The Netherlands.

1 Tempel LW, Perlmutter JS. Abnormal cortical responses in patients with writer's cramp. *Neurology* 1993;43:2252–7.
2 van Royen E, Verhoeff NF, Speelman JD, Wolters EC, Kuiper MA, Janssen AG. Multiple system atrophy and progressive supranuclear palsy. Diminished striatal D2 dopamine receptor activity demonstrated by 123I-IBZM single photon emission computed tomography. *Arch Neurol* 1993;50:513–6.
3 Ikoma K, Samii A, Mercuri B, Wassermann EM, Hallett M. Abnormal cortical motor excitability in dystonia. *Neurology* 1996;46:1371–6.
4 Gerfen CR, Engber TM, Mahan LC, Susel Z, Chase TN, Monsma FJ Jr, Sibley DR. D1 and D2 dopamine receptor-regulated gene expression of striatonigral and striatopallidal neurons. *Science* 1990;250:1429–32.
5 Dawson VL, Dawson TM, Wamsley JK. Muscarinic and dopaminergic receptor subtypes on striatal cholinergic interneurons. *Brain Res Bull* 1990;25:903–12.
6 Kawaguchi Y, Wilson CJ, Augood SJ, Emson PC. Striatal interneurones: chemical, physiological and morphological characterisation. *TINS* 1995;18:527–35.
7 Hallett M. Is dystonia a sensory disorder? *Ann Neurol* 1995;38:139–40.
8 Burke RE, Karanas AL. Quantitative morphological analysis of striatal cholinergic neurons in perinatal asphyxia. *Ann Neurol* 1990;27:81–8.

Chronic sensory ataxic neuropathy and ophthalmoplegia with oculomotor nerve hypertrophy associated with IgM antibodies against gangliosides containing disialosyl groups

Recent studies have shown that serum antiganglioside antibodies may be involved in various immune mediated peripheral neuropathies. We report an investigation of antiganglioside antibodies in a patient with chronic sensory neuropathy and ophthalmoplegia associated with oculomotor nerve hypertrophy.

A 40 year old man had been in good health when he developed subacute diplopia in 1987. At the age of 45, he developed a moderately unsteady gait after an infection of the upper respiratory tract. The symptom gradually worsened and he was unable to run at the age of 46. At the age of 48, he was admitted to hospital because of progressive numbness in all limbs and difficulty in performing fine motor movements. Treatment