

Pseudoathetosis: three cases of delayed-onset movement disorder

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Abstract

Pseudoathetosis refers to choreoathetoid movements occurring in association with loss of proprioception. The responsible lesions can be located most anywhere and indicates a disruption of the proprioceptive pathway, from peripheral nerves to the parietal cortex. We describe the clinical courses, radiologic findings and treatments of 3 patients with spinal pseudoathetosis. Patients 1 and 3 experienced the movement disorder 2 years and 6 months, respectively, after resections of spinocerebellar tumors. Patient 2 had bilateral arm weakness from cervical disc herniation one year prior to the onset of pseudoathetosis. MRI of the cervical spine revealed lesions in the dorsolateral column of the cervical cord as the cause of the impaired proprioceptive sensation. Since the clinical course of two patients had shown delayed onset following a neuro-surgical procedure, the consequent neuroplasticity of disruptive sensory pathways was thought to be the explanation for the development of the pseudoathetosis. Pseudoathetosis in the second case could be due to a natural course of progression from cervical cord compression. In conclusion, pseudoathetosis is a rare movement disorder and the pathophysiology remains an enigma.

INTRODUCTION

Pseudoathetosis is a rare movement disorder and refers to choreoathetoid movements occurring in association with a loss of proprioception and/or kinesthetic dysfunction. The responsible lesions indicate disruption of the proprioceptive pathway and can be located most anywhere from peripheral nerves to the parietal cortex. Analogous to Romberg's sign, the abnormal posturing is most pronounced when the eyes are closed as visual inputs are unavailable to guide corrective movements. We report here three cases of pseudoathetosis of delayed-onset.

CASE REPORTS

Patient 1

A 74-year-old woman had surgical removal of a cerebellar tumor 2 years ago. The patient presented with headache of the occipital area radiating to her neck, associated with tetraplegia, and ataxia. Her pre-operative MRI revealed a heterogeneous intensity mass extending from the medulla to the cervical spinal cord (C) level 2 which was enhanced after gadolinium injection (Figure 1A).

Post operatively, although the headache and neck pain had resolved, ataxia and clumsiness were still present. The pathological finding was compatible with hemangioblastoma. Systemic examinations were normal except for high blood pressure. Her follow-up MRI 3 months after surgery revealed remnants of the ventral medulla and cervical cord at the C1-C2 level without syringomyelia (Figure 1B).

At one and a half years post operatively, she complained of involuntary movements in her fingers and toes. The abnormal movements persisted at all times with characteristics of dystonic posturing and a piano-playing like pattern. Her daily activities were disturbed secondary to unaware dropping objects and walking difficulties. She denied experiencing vertigo or pain, but had numbness in the extremities. Neurological examination revealed slow, alternating and writhing movements involving flexion and extension of her toes and fingers. Pseudoathetosis had become more pronounced when raising both arms in the outstretched position with eyes closed (Video 1). Mild left upper motor neuron facial palsy was also seen while other cranial nerve functions were unremarkable. Her muscle

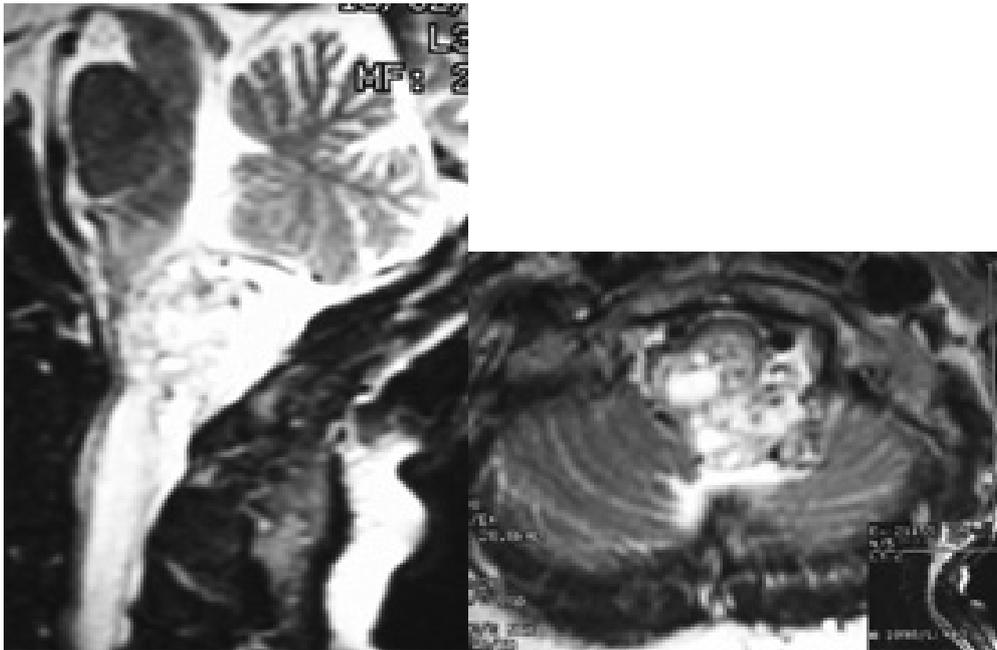


Figure 1A. Pre-operative MRI brain which included upper C-spine (T2W) of Patient 1 showed a heterogeneous intensity mass extending from the medulla to C2 level of the spinal cord.

strength was 4+. Pinprick sensation was intact. Proprioception and vibratory sensation were impaired at both extremities left greater than right. Tendon jerks were hyperreflexia in upper extremities but diminished in lower extremities.

Babinski's sign revealed dorsal response on the left side. Cerebellar examination showed dysmetria bilaterally and truncal ataxia. Complete blood count (CBC), chemistry and thyroid function test were normal. The serologic test for syphilis was negative. The nerve conduction study showed no peripheral neuropathy. Somatosensory evoked potential showed electrophysiological evidence of conduction block from the cervicomedullary junction to the thalamocortical and primary sensory cortex. Following counseling with the patient and her caregiver; donapezil, gabapentin (for pain relief) and decaquion were prescribed, as well as prenapril for hypertension. The



Figure 1B. The follow-up MRI of the brain and cervical cord (T2W) about 3 months after the operation showed remnants of the ventral medulla and C1-C2 level of the spinal cord. The tumor and the dorsal column were completely removed.

pseudoathetosis was improved but still persisted along with ataxia.

Patient 2

A 74-year-old female developed numbness and weakness involving bilateral hands and feet over one year. She experienced occasional gait ataxia and radicular pain beginning from the lower cervical to the mid-thoracic area during head turning. She had no vertigo, visual disturbances, or dysarthria. Two months prior to admission the pain and ataxia worsened. She developed slow, writhing, cramp-like, choreoathetoid movements of her fingers bilaterally (Video 2). Physical examination was positive only for essential hypertension. Neurological examination showed normal speech, intact cranial nerves, grade 4 motor strength, normally pinprick sensation, but hyperreflexia. Impairment of proprioception was detected at both hands and fifth toes bilaterally. Tandem walk was ataxia. CBC, chemistry, serum vitamin B12 and folic acid were normal. Serologic tests for Venereal Disease Research Laboratory (VDRL) and Treponema pallidum haemagglutination assay (TPHA) were non-reactive. MRI brain revealed slight brain atrophy, multiple small high-intensity lesions in fluid-attenuated inversion recovery (FLAIR) sequence representing lacunar infarctions at both frontoparietal white matters, and normal cerebellum and brainstem. MRI C-spine showed posterior disc herniation at levels C2-C7 with significant compression on the C3-C4 spinal cord (Figure 2

A&B). Decompression surgery was offered to the patient but she declined. Calcium channel and beta-blockers were prescribed for hypertension. To decrease spasticity and pain, benzodiazepine and gabapentin were prescribed. Four months after medical treatment, her pain subsided and the pseudoathetosis was partially improved, however, the spasticity persisted.

Patient 3

A 32-year-old pregnant woman (gestational age 20 weeks) was admitted to Neurosurgery service because of severe subacute quadriparesis over 2 weeks in duration. Her MRI C-spine revealed well demarcated, hypointensity in T1 weighted images and hyperintensity in T2 weighted images, intramedullary lesion involving C1-C6. After gadolinium injection, peripheral ring enhancement and cystic-like portion parenchymal edema from the medulla to the thoracic spinal cord (T) level 7 were seen (Figure 3A&B). Differential diagnoses considered were astrocytoma, ependymoma, or lymphoma. CBC, renal function, blood chemistry and lactate dehydrogenase were normal. Due to the emergent dysfunction of her neurological status, total removal of the mass was immediately performed. High-dose, intravenous corticosteroid was also prescribed and continued throughout the postpartum period. Pathology examination showed increased glial cells, lymphocytes, and foamy macrophages indicating an inflammatory process. No malignant cell was detected. The weakness improved 2 weeks post-op. Follow-up

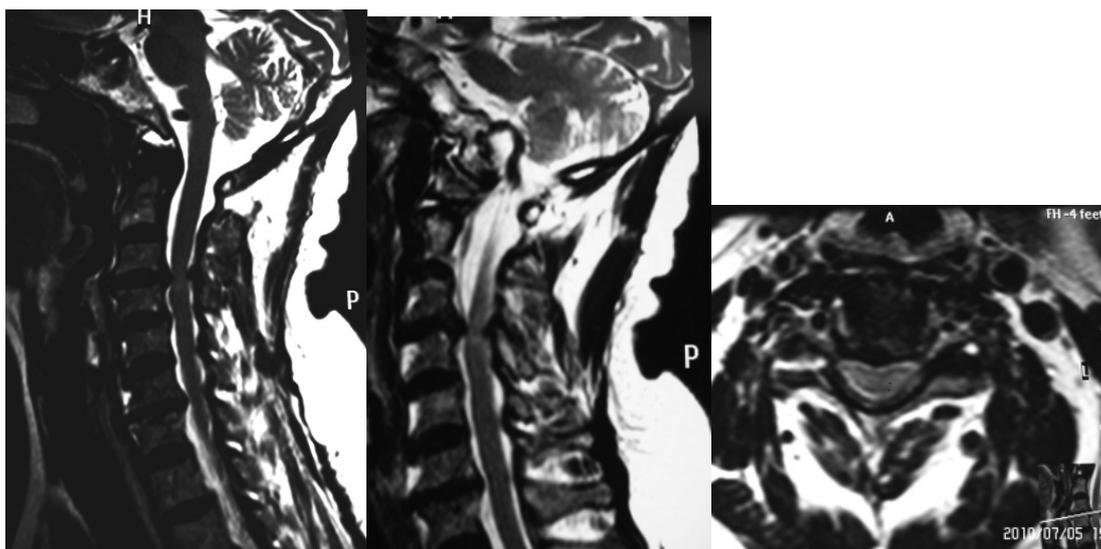


Figure 2A&B. MRI C-spine (T2W) of Patient 2 showed posterior disc herniation of levels C2-7 with a significant compression on the C3-C4 cord.

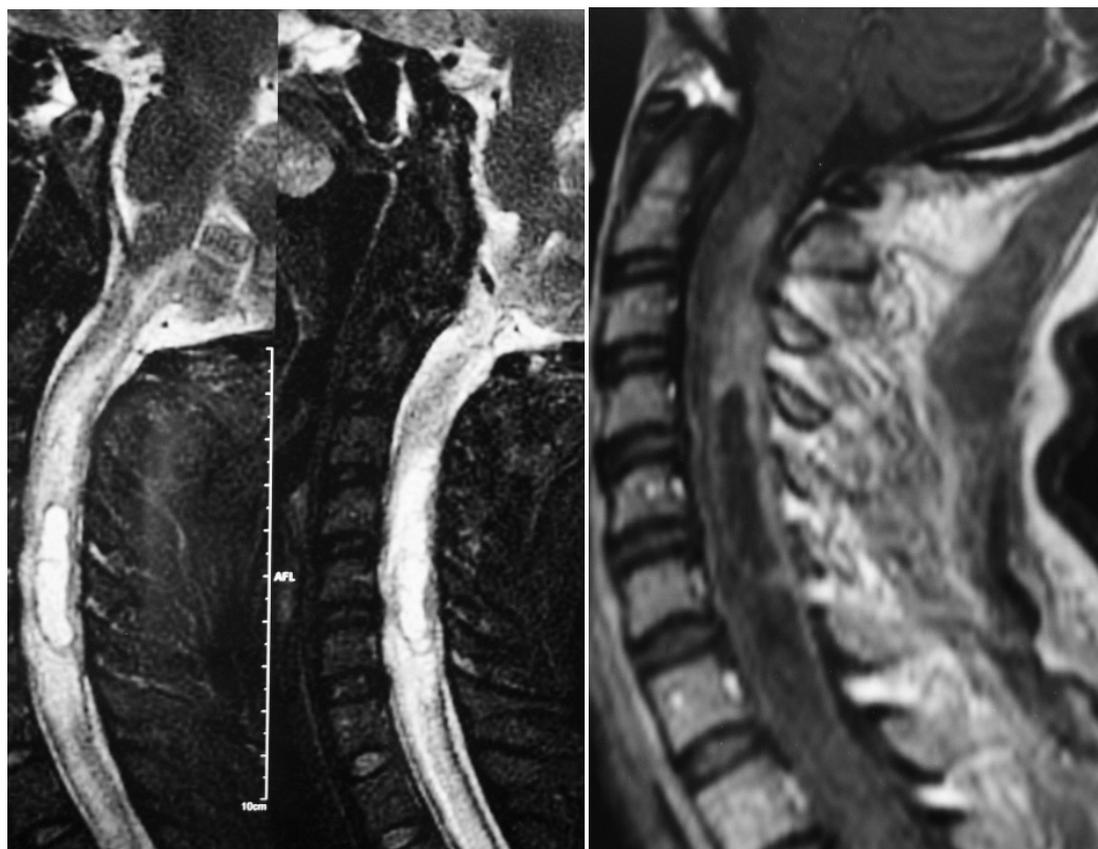


Figure 3A&B. MRI C-spine of Patient 3 revealed well demarcated, hypointensity in T1W and hyperintensity in T2W, intramedullary lesion involving levels C1-C6. The peripheral ring enhancement and cystic-like portion parenchymal edema were seen after gadolinium injection.

MRI C-spine at 1 month and 3 months showed no recurrence of the mass and the spinal cord edema was markedly improved. Syringomyelia was present from C6-T6 (Figure 3C&D). Despite development of pre-eclampsia at the end of the third trimester treated with bed rest and magnesium sulfate, a healthy child was eventually delivered by Caesarian section. Six months after surgery she suffered from severe spastic pain and noticed involuntary movements of her fingers bilaterally when her arms were outstretched and eyes closed. Neurological examinations revealed pseudoathetosis of her fingers more prominent on the right hand, grade 4 motor strength and impairment of proprioception (Video 3). To decrease spastic pain, gabapentin was administered and gradually titrated to optimal dosage. Pseudoathetosis completely disappeared 3 weeks after medical treatment.

DISCUSSION

While athetosis refers to a particular movement disorder, typically affecting the hands and feet and chiefly attributed to putaminal and/or thalamic lesions, pseudoathetosis is characterized by choreoathetoid movements related to loss of proprioceptive sensation. Proprioception is one's spatial sense of body position while kinesthesia infers awareness of body position while in motion, yet these terms are sometimes interchangeable. The functional neuro-anatomy for proprioception is comprised of two major pathways; 1) the pathway for conscious proprioception that plays a role for kinesthesia and touch discrimination and 2) pathways of non-conscious proprioception that regulate muscle contraction and co-ordinate movement.^{1,2}

The neuro-anatomical pathway for conscious proprioception begins peripherally from cutaneous mechanoreceptors and proprioceptive receptors to myelinated nerve fibers, dorsal roots, dorsal horns

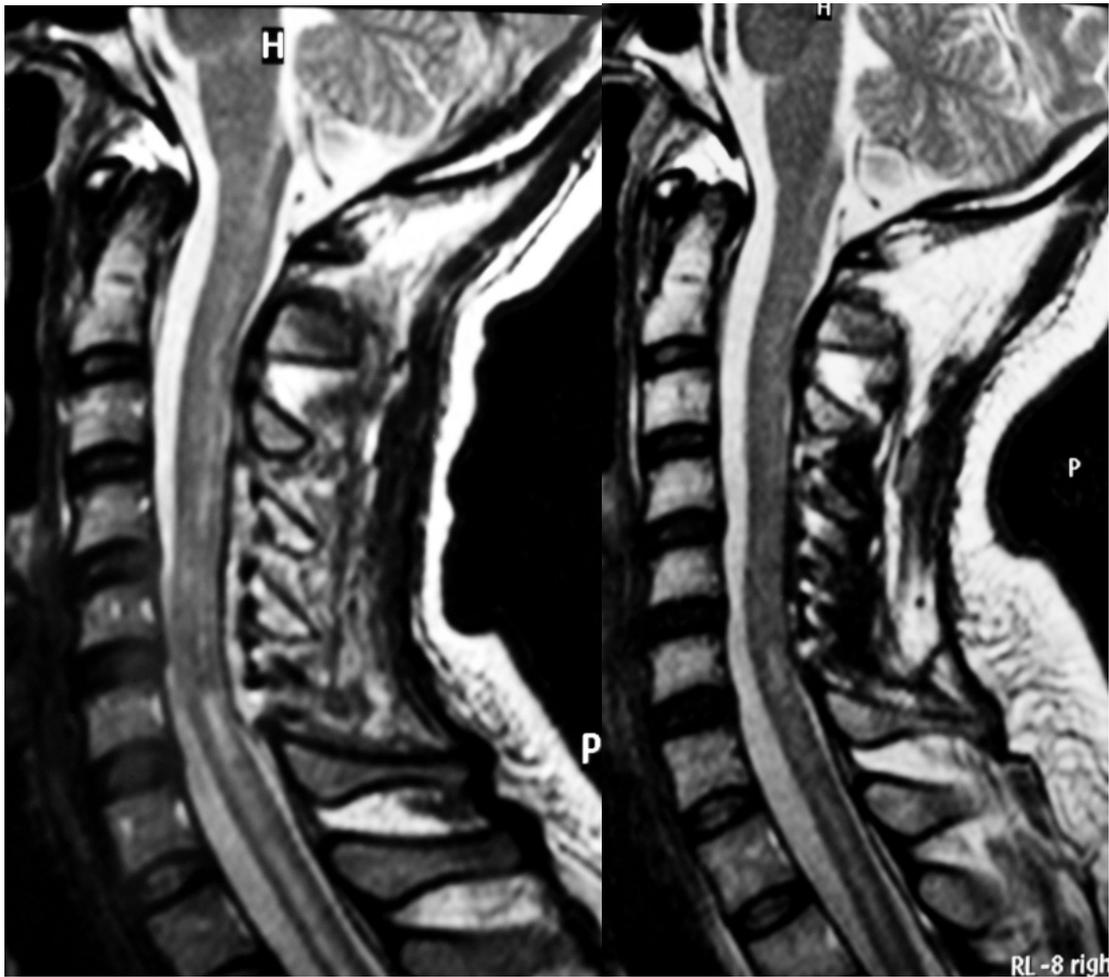


Figure 3C&D. Follow-up MRI (T2W) at 1 month and 3 months after surgery showed no recurrence of the mass. Syringomyelia was present from C6-T6.

of the spinal cord where impulses enter to synapse second-order neurons and then send afferent fibers to form the gracile and cuneate tracts in the dorsal column. Both of these tracts project on neurons in the ipsilateral dorsal column of the medulla before sending fibers up to decussate in the tegmentum that then are known as the medial lemniscus. This tract travels to project on the ventroposterolateral (VPL) nucleus of the thalamus. Axonal fibers from VPL nucleus finally terminate in the primary sensory cortex of the parietal lobe. Non-conscious proprioception is mediated via the dorsal and ventral spinocerebellar tract. These circuits convey impulses from Golgi tendon organ and muscle spindle by travelling in the spinal cord and brainstem before terminating in the cerebellum.

Integration of proprioception is the impact of afferent, efferent and multiple interconnections at various levels along the described pathway. A

possible framework for interpreting proprioceptive signals at the spinal level is proposed to be based on global limb information.³⁻⁵ Impairment of proprioception seems to alter this fine balance for the detection of limb position and kinesthetic information with normal cortical commands resulting in pseudoathetosis.

While the responsible lesions for pseudoathetosis can be found anywhere along this sensory pathway, many reports have shown lesions commonly involving the dorsal column of the cervical spinal cord.⁶⁻¹⁴ This similarity was also present in our patients in that their lesions were located in the dorsolateral column of the cervical cord and disrupted the proprioceptive neuroanatomical pathway which contributed to the development of pseudoathetosis.

Various etiologies resulting in pseudoathetosis have been reported and include; post-surgical resection of spinal tumors (same as in our Patient

1 and 3), syringomyelia related to Arnold-Chiari malformation⁶, trauma⁷, multiple sclerosis (with responsible lesions in either the brain or spinal cord)^{8,11-12}, cervical disc herniation (similar to our second patient)⁹, infarction^{10,15-16}, peripheral neuropathy¹⁰, vitamin B 12 deficiency¹³⁻¹⁴, osmotic demyelination¹⁷, leprosy¹⁸, and viral infections.¹⁹

We hypothesize that pseudoathetosis is chiefly due to an extreme imbalance between excitatory and inhibitory stimulation. Furthermore, the disinhibition, or decrease in inhibitory feedback may play a primary role in the pathophysiology of pseudoathetosis. In support of this are two findings in our case series; 1) the severity and onset of movement dysfunction coincided with and was dependent upon recovery of motor strength. This hypothesis may explain why the Patient 1 and 3 did not develop movement disorder immediately after surgery; and 2) administration of gabapentin improved the patient's pseudoathetosis. Gabapentin, a known GABA analogue is a consistent inhibitory substance that modulates synaptic transmission, blocks signal transduction and inhibits glutamate release. These actions result in the therapeutic effects for epilepsy, pain and spasticity.²⁰ However, there is no report of routine use of gabapentin in pseudoathetosis. Interestingly, our patients received benefits from this drug not only by reduction of the spastic pain, but also relieving the abnormal movement. Perhaps this drug aids in bringing the excitatory and inhibitory arms into a better balance.

In conclusion, pseudoathetosis is a rare movement disorder which invariably involves abnormalities in proprioception yet the pathophysiology is not fully understood. There is no current prevalent treatment for these patients. We feel that our findings may warrant a larger randomized blinded study of drug intervention for pseudoathetosis.

Legend of the Videos

Video 1. [http://neurology-asia.org/content/18/2/neuroasia-2013-18\(2\)-217-v1.mp4](http://neurology-asia.org/content/18/2/neuroasia-2013-18(2)-217-v1.mp4). Video of Patient 1 showing pseudoathetosis become more pronounced when raising both arms in the outstretched position with eyes closed.

Video 2. [http://neurology-asia.org/content/18/2/neuroasia-2013-18\(2\)-217-v2.mp4](http://neurology-asia.org/content/18/2/neuroasia-2013-18(2)-217-v2.mp4). Video of Patient 2 showing pseudoathetosis become more pronounced when raising both arms with eyes closed. There was dystonic posture of the fingers and some fingers moved involuntarily.

Video 3. [http://neurology-asia.org/content/18/2/neuroasia-2013-18\(2\)-217-v3.mp4](http://neurology-asia.org/content/18/2/neuroasia-2013-18(2)-217-v3.mp4). Video of Patient 3 showing pseudoathetosis become more pronounced on the right hand and aggravated by arm raised with eyes closed and under distraction.

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DISCLOSURE

Conflict of interest: None

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