Case Reports

Painful Limbs/Moving Extremities

Report of Two Cases

**Tsuyoshi Miyakawa MD, Mitsunori Yoshimoto MD,
Tsuneo Takebayashi MD, Toshihiko Yamashita MD**

Received: 25 January 2010 / Accepted: 7 June 2010 / Published online: 29 June 2010
© The Association of Bone and Joint Surgeons® 2010

Abstract

Background Painful limbs/moving extremities is a relatively rare condition characterized by aching pain in one limb and involuntary movement in the affected fingers or toes. Its pathomechanism is unknown. We report two patients with painful limbs/moving extremities. In one patient with a painful arm and moving fingers, the symptoms were resolved after surgery.

Case Descriptions Patient 1 was a 36-year-old man with a painful arm and moving fingers. Treatment with administration of analgesics was not effective. Postmyelographic CT showed stenosis of the right C5/C6 foramen attributable to cervical spondylosis and a defect of the contrast material at the foramen. He was treated with cervical foraminotomy. Patient 2 was a 26-year-old woman with a painful leg and moving toes. The pain and involuntary movement appeared 2 weeks after discectomy at L5/S1. Lumbar MRI and myelography showed no indications of

nerve root compression. She was treated with a lumbar nerve root block. The pain and involuntary movement completely disappeared in both patients after treatment.

Literature Review Numerous studies report treatments for painful limbs/moving extremities, but few report successful treatment. Recently, botulinum toxin A injection and epidural spinal cord stimulation have been used and are thought to benefit this condition. Successful surgical treatment previously was reported for only one patient.

Purposes and Clinical Relevance If imaging indicates compression of nerve tissue, we believe surgical decompression should be considered for patients with painful limbs/moving extremities who do not respond to nonoperative treatment.

Introduction

Painful arm and moving fingers (PAMF), which is characterized by aching pain in the upper extremity and spontaneous involuntary movements of the fingers, was first reported by Verhagen et al. [39] in 1985. A similar and more common syndrome in the lower extremity is called painful legs and moving toes (PLMT), first coined by Spillane et al. [32] in 1971. Papapetropoulos and Argyriou [20] described these disorders as painful limbs/moving extremities (PLME). These were divided into several subtypes according to localization of movement and pain and laterality of symptoms. PLME is a relatively rare disorder and its pathomechanism is unknown.

We treated two patients with PLME. The first was a patient with PAMF in whom cervical nerve root compression potentially led to the symptoms, as indicated by improvement after cervical foraminotomy. The second was a patient with PLMT after surgery for lumbar disc

Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

Each author certifies that his or her institution approved the reporting of this case report, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

Electronic supplementary material The online version of this article (doi:10.1007/s11999-010-1437-y) contains supplementary material, which is available to authorized users.

T. Miyakawa (✉), M. Yoshimoto, T. Takebayashi,
T. Yamashita
Department of Orthopaedic Surgery, Sapporo Medical
University School of Medicine, S1 W16, Sapporo,
Hokkaido 060-8543, Japan
e-mail: tm244-38@gj9.so-net.ne.jp

herniation. We found only one previous report of patients with PAMF whose symptoms were resolved after surgery [34]. We herein report these two patients and review the literature.

Case Reports

Patient 1

A 36-year-old man was referred to our hospital after a 1-month history of pain in his neck and right scapular region, followed by aching or burning pain in his right thumb, index finger, and upper arm and involuntary movements of the right thumb. Treatment with administration of analgesics was not effective. He and his family had no remarkable contributory history including psychogenic disease.

On examination, there was aching pain at rest in his right thumb and index finger and involuntary flexion-extension movement of the thumb at the carpometacarpal joint (Video 1, Supplemental Website Material; supplemental materials are available with the online version of CORR).

Movement of the thumb increased in proportion to the degree of pain and could not be stopped by conscious effort. Moreover, the patient could not voluntarily reproduce the movement on the unaffected side when asked to do so. It disappeared during sleep but otherwise, basically, was a continuous movement. Neurologic examinations showed Grade 4 of 5 in manual muscle testing of the right biceps muscle and wrist extensor muscles, sensory disturbance in the right C6 distribution, weakness in the right brachioradialis tendon reflex, and radiating pain to the thumb and index finger reproduced by neck extension and side flexion (positive test using the criteria of Spurling and Scoville [33]) on the right side, indicating right C6 radiculopathy. MRI showed no compression of the spinal cord but minimal stenosis at the right C5/C6 foramen. Also, postmyelographic CT showed stenosis of the right C5/C6 foramen attributable to cervical spondylosis and a defect of the contrast material at the foramen (Fig. 1). A right C6 nerve root block was performed and resulted in temporary disappearance of the pain. The pain recurred the next morning and the involuntary movement did not stop while the nerve block was in effect.

Right C6 cervical spondylotic radiculopathy was diagnosed on the basis of this patient's pain. We consulted a neurologist and planned to observe the patient closely and obtain additional studies including electromyography (EMG) and brain MRI. However, because the pain was severe and resistant to oral medication or nerve root block, we proceeded with surgery for the right C6 cervical spondylotic radiculopathy. Two months later a C5 laminoplasty and right C5/C6 foraminotomy were performed.

Fig. 1 A postmyelographic CT scan shows stenosis of the right C5/C6 foramen (arrow) attributable to cervical spondylosis and a defect of the contrast material at the foramen.

After the surgery, the pain and involuntary movements had completely disappeared. At 2 years followup, the patient had no recurrence of pain or involuntary movements.

Patient 2

A 26-year-old woman was referred to our hospital after a 6-month history of left sciatica unsuccessfully treated by nonsurgical therapies. Lumbar disc herniation at L5/S1 was diagnosed and she underwent discectomy. Two weeks later, she felt pain in her left leg and involuntary movement of her left toes appeared. The movement was a combination of flexion-extension and adduction-abduction, and each toe motion was independent (Video 2, Supplemental Website Materials; supplemental materials are available with the online version of CORR). Moreover, the movement could not be stopped by conscious effort and the patient could not voluntarily reproduce the movement on the unaffected side when asked to do so. However, the movement did disappear during sleep. Lumbar MRI and myelography showed no indications of nerve root compression. The neurologist to whom we referred the patient ruled out any psychogenic disorder and other neurologic movement disorders by MRI of the brain. The pain was not relieved and the involuntary movement was not resolved by a caudal block and administration of clonazepam, diazepam, haloperidol, and adenosine triphosphate disodium. A left S1 nerve root block had a temporary effect, resulting in disappearance of the pain in her leg and the involuntary movement of the toes for a few days. Therefore, we performed the same nerve root block seven times, and 4 months after administration of the first nerve root block, the pain and involuntary movement had completely disappeared. Three months after disappearance of the pain and involuntary movement, the patient was lost to followup because she changed her residence.

Discussion

PLME is defined as the association of aching or burning pain in at least one limb and involuntary movement of at least one finger or toe. The involuntary movement is spontaneous and continuous and characterized by flexion-extension and/or abduction-adduction movement of affected fingers or toes. Typically, the movement increases in proportion to the degree of pain and cannot be reproduced on the unaffected side. Some of the patients can stop the movement for a short time by conscious effort and the movement disappears during sleep. There are some reports of patients with PLME without pain, called painless limbs/moving extremities [2–5, 21, 31, 41].

We identified 12 patients with PLME of the upper extremity (PAMF), and of these patients, only one was successfully treated surgically [34] (Table 1). There are more reported cases of PLME in the lower extremity (PLMT) than in the upper extremities (PAMF). However, there have been no reports of PLMT being successfully resolved surgically, and only two reports of PLMT being partially or temporarily improved surgically [14, 42] (Table 2).

PLME is a relatively rare disorder; therefore, the pathophysiology is not fully understood. Based on the effectiveness of the lumbar sympathetic ganglion block, Spillane et al. [32] speculated that abnormal impulses from afferent fibers in the sympathetic nervous system activated ventral horn cells in the spinal cord, resulting in the involuntary movement. Nathan [17] proposed that

abnormal stimulation to the nerve root or peripheral nerve caused pain in the limbs and evoked involuntary movement by stimulating ventral horn cells via the spinal interneuron. Meanwhile, as involuntary movement does not appear during sleep, Schott suggested it was associated with the reticular activating system [28], which is controlled by consciousness.

In our patients, the pain and involuntary movement disappeared after decompression or block of the spinal nerve root, supporting Nathan's theory regarding the pathomechanism of PLME (Fig. 2). He theorized that ectopic impulses of the nerve root caused by irritation are conducted to the spinal dorsal horn neurons through the afferent pathway, leading to pain perception. At the same time, the impulses from the nerve root would excite the local spinal interneuron and lead to stimulation of spinal ventral horn neurons, resulting in involuntary movement of the extremity.

Nonsurgical treatments, including administration of benzodiazepine or γ -aminobutyric acid and sympathetic ganglion block, are commonly performed [6–8, 13, 15, 18, 19, 22, 24–29, 32, 35–37, 40, 42] for patients with PLME because the central nervous system or sympathetic nervous system also is considered to be the cause of PLME, as mentioned above. However, symptoms of PAMF (Table 1) and PLMT (Table 2) usually are resistant to such treatments.

Dressler et al. [4] reported that sympathetic ganglion block was effective in approximately 50% of patients with PLME but the effects were transient. Guieu et al. [9]

Table 1. Review of the literature (painful arms and moving fingers)

Study	Age (years), gender	Pathology	Treatment	Clinical outcome	
				Pain	Involuntary movement
Verhagen et al. [39]	54 F	Brachial plexus			
Funakawa et al. [8]	52 M	Peripheral nerve (trauma)	Oral medication	No change	No change
Ebersbach et al. [6]	64 M		Oral medication	No change	No change
Jabbari et al. [13]	35 F	Peripheral nerve (trauma)	Oral medication	No change	No change
			Botulinum toxin A injection	No change	Transient relief
Supiot et al. [35]	68 M	Brachial plexus	Transportation of the ulnar nerve	No change	No change
			Oral medication (calcitonin)	Transient relief	Decreased
	25 F	Nerve root (CSR)	Oral medication (calcitonin)	Transient relief	Transient relief
	49 M	Peripheral nerve (trauma)	Oral medication (amantadine)	Decreased	Decreased
	66 F	CNS (stroke)	Oral medication	No change	No change
Sudo et al. [34]	56 F	Spinal cord (CSM)	Cervical laminoplasty	Disappeared	Disappeared
Singer and Papapetropoulos [31]	20 F	Painless	Botulinum toxin A injection	None	Disappeared
Schwingschuh and Bhatia [29]	62 F	Hypothyroidism	Oral medication	No change	No change
Current study	36 M	CSR	Cervical foraminotomy	Disappeared	Disappeared

F = female; M = male; CNS = central nervous system; CSR = cervical spondylotic radiculopathy; CSM = cervical spondylotic myelopathy.

Table 2. Review of the literature (painful legs and moving toes)

Study	Age (years), gender	Pathology	Treatment	Clinical outcome	
				Pain	Involuntary movement
Spillane et al. [32]	48 M	SNS	Block of SNS	Transient relief	Transient relief
			Sympathectomy	No change	No change
	54 M	SNS	Block of SNS	Disappeared	Disappeared
	67 F, 54 M	SNS	Block of SNS	Transient relief	Transient relief
Okamoto et al. [18]	68 F, 53 M		Oral medication	No change	No change
	62 F		Oral medication		No change
			Block of SNS		Disappeared
Nathan [17]	46 F	Nerve root (herpes zoster)			
	30 F	Nerve root (trauma)			
	57 M	Nerve root (cyst)	Nerve root decompression	No change	No change
Schott [28]	62 F	Peripheral nerve (trauma)			
	69 F	Trauma	Block of SNS	Transient relief	Transient relief
	56 F, 77 F	Trauma	Block of SNS	No change	No change
Wulff [42]	66 M, 57 F		Oral medication	No change	No change
	56 M, 64 M		Oral medication	NC	NC
	41 F	Herniotomy	Herniotomy	Disappeared	Transient relief
Montagna et al. [15]	60 M	Peripheral nerve (neuropathy)	Oral medication	Transient relief	No change
	74 F, 76 F	Peripheral nerve (neuropathy)	Oral medication	No change	No change
Schoenen et al. [27]	71 F, 80 F, 49 M, 69 F, 68 F, 74 M		Oral medication	No change	No change
Sahashi et al. [24]	62 F, 75 M		Block of SNS	No change	No change
			Oral medication	No change	No change
Sandyk [26]	51 F	Neuroleptic	Oral medication (baclofen)	Decreased	Decreased
			Oral medication (clonazepam)	Decreased	No change
			Resection	Decreased	Disappeared
Guieu et al. [10]	29 M	CNS, peripheral nerve (trauma)	Clonazepam injection	Transient relief	Transient relief
Uchihara et al. [38]	56 M	Hypophysectomy	TENS	Disappeared	
			Epidural block	Transient relief	Transient relief
	46 M	Parkinson's disease	Block of SNS	Disappeared	Disappeared
			Epidural block	Transient relief	Transient relief
Walters et al. [41]	25 M	Peripheral nerve Painless	Block of SNS	Disappeared	Disappeared
				None	
Guieu et al. [9]	30 M	Peripheral nerve (trauma)	ATP injection	Disappeared	
	72 F		ATP injection	Disappeared	
Dressler et al. [4]	36 M	Spinal cord (trauma)	Block of SNS	No change	No change

Table 2. continued

Study	Age (years), gender	Pathology	Treatment	Clinical outcome	
				Pain	Involuntary movement
Mosek et al. [16]	76 F	Nerve root (herpes zoster)	Block of SNS	Transient relief	Transient relief
	49 F	Nerve root	Block of SNS	No change	No change
	69 F	Nerve root			
	28 M	Nerve root (hemangioma)			
	66 F, 73 M	Nerve root			
	28 F	Peripheral nerve (trauma)	Block of SNS	Decreased	Decreased
	68 F	Peripheral nerve (trauma)			
	67 F	Peripheral nerve (trauma)	Block of SNS	Transient relief	Transient relief
	66 F, 74 F	Peripheral nerve (trauma)	Block of SNS	No change	No change
	61 F, 72 F	Peripheral nerve (neuropathy)			
	69 F, 54 M	Peripheral nerve (neuropathy)			
	67 F, 72 F				
	65 F		Block of SNS	No change	No change
	64 F				
	28 M, 36 M	Painless		None	
45 M	Painless		None		
Pla et al. [23]	57 F	Nerve root	Laminectomy Dorsal root block	No change Transient relief	No change Transient relief
	35 M	Peripheral nerve (neuropathy)	Block of plantar nerve	Transient relief	Transient relief
Ebersbach et al. [6]	64 M		Foot orthosis Oral medication	Decreased No change	Decreased No change
	37 M	Peripheral nerve (neuropathy)	Oral medication	No change	No change
Okuda et al. [19]	36 F		Block of SNS Epidural block	Decreased Disappeared	Disappeared Disappeared
	56 M		Epidural block	Transient relief	Transient relief
	50 F		Block of SNS Oral medication Epidural block	No change No change Transient relief	No change No change Transient relief
	63 F		Block of SNS	Transient relief	Transient relief
	38 M, 51 M	Peripheral nerve (neuropathy), HIV	Oral medication	No change	No change
Sanders et al. [25]	76 F		Oral medication	No change	No change
Takahashi et al. [36]	51 M		Epidural block, TENS Block of SNS	No change Transient relief	No change Transient relief
			ESCS	Decreased	Decreased
	38 F, 70 F	Painless		None	
Ikeda et al. [12]	75 F	Spinal cord (herpes zoster)	Block of SNS Epidural block, ESCS	No change No change	No change No change

Table 2. continued

Study	Age (years), gender	Pathology	Treatment	Clinical outcome	
				Pain	Involuntary movement
Villarejo et al. [40]	66 M		Oral medication (gabapentin)	Disappeared	Disappeared
Papapetropoulos and Singer [21]	20 F	Wilson's disease Painless	Oral medication (zinc acetate)	None	Disappeared
Aizawa [1]	73 F		Oral medication (gabapentin)	Decreased	No change
Guimaraes et al. [11]	60 M	Hashimoto disease	Prednisolone	No change	No change
Bermejo and Zabala [2]	82 F	Spinal cord Painless	Laminectomy	None	Disappeared
DiFabio et al. [3]	74 F	Peripheral nerve Painless	Oral medication (quetiapene)	None	Transient relief
Eisa et al. [7]	62 M, 76 F		Oral medication BTA injection	No change Decreased	No change Decreased
Schwingenschuh and Bhatia [29]	62 F	Hypothyroidism	Oral medication	No change	No change
Current study	26 F	Nerve root (after herniotomy)	Nerve root block	Disappeared	Disappeared

M = male; F = female; SNS = sympathetic nervous system; CNS = central nervous system; TENS = transcutaneous electrical nerve stimulation; ATP = adenosine triphosphate; ESCS = epidural spinal cord stimulation; BTA = botulinum toxin A.

Fig. 2 According to the interneuron theory of Nathan [17], pain is perceived through the lateral spinothalamic tract. The impulse excites the spinal interneuron and leads to stimulation of spinal ventral horn cells, resulting in involuntary movement of the extremity.

treated two patients with PLMT by injection of adenosine triphosphate. The pain disappeared but the effect on movement was not mentioned. Okuda et al. [19] suggested several advantages of epidural block over sympathetic ganglion block, and Takahashi et al. [36] reported the benefit of epidural spinal cord stimulation for PLMT. Recently, treatment with botulinum toxin A (BTA) injection was reported by Singer and Papapetropoulos [31] and Eisa et al. [7]. The injection resulted in substantial pain relief and reduction of involuntary movement owing to

reduction of the muscle spindle leading to decreased activity of the gamma loop and central sensitization.

Sudo et al. [34] reported the only case of a patient with PAMF in whom pain and involuntary movement were resolved by surgery. In their patient, cervical radiculopathy or segmental myelopathy was thought to be the cause of the symptoms, and bilateral open-door laminoplasty was performed. Similarly, the symptoms in our first patient were resolved by decompression of the nerve root. Therefore, we believe surgical treatment should be considered for patients in whom compression of nerve tissue is recognized by MRI and/or CT but in whom no response is obtained by non-surgical treatment.

References

1. Aizawa H. Gabapentin for painful legs and moving toes syndrome. *Intern Med.* 2007;46:1937.
2. Bermejo PE, Zabala JA. "Painless legs and moving toes" syndrome due to spinal cord compression. *Eur Spine J.* 2008; 17(suppl 2):S294–S295.
3. Di Fabio R, Casali C, Pierelli F. Quetiapine: an alternative treatment in painless legs and moving toes. *Mov Disord.* 2008;23: 1326–1328.
4. Dressler D, Thompson PD, Gledhill RF, Marsden CD. The syndrome of painful legs and moving toes. *Mov Disord.* 1994;9: 13–21.
5. Dziewas R, Kühlenbäumer G, Okegwo A, Lüdemann P. Painless legs and moving toes in a mother and her daughter. *Mov Disord.* 2003;18:718–722.

6. Ebersbach G, Schelosky L, Schenkel A, Scholz U, Poewe W. Unilateral painful legs and moving toes syndrome with moving fingers: evidence for distinct oscillators. *Mov Disord.* 1998;13:965–968.
7. Eisa M, Singer C, Sengun C, Russel A, Jabbari B, Papapetropoulos S. Treatment of painful limbs/moving extremities with botulinum toxin type A injections. *Eur Neurol.* 2008;60:104–106.
8. Funakawa I, Mano Y, Takayanagi T. Painful hand and moving fingers: a case report. *J Neurol.* 1987;234:342–343.
9. Guieu R, Sampiéri F, Pouget J, Guy B, Rochat H. Adenosine in painful legs and moving toes syndrome. *Clin Neuropharmacol.* 1994;17:460–469.
10. Guieu R, Tardy-Gervet MF, Blin O, Pouget J. Pain relief achieved by transcutaneous electrical nerve stimulation and/or vibratory stimulation in a case of painful legs and moving toes. *Pain.* 1990;42:43–48.
11. Guimarães J, Santos L, Bugalho P. Painful legs and moving toes syndrome associated with Hashimoto's disease. *Eur J Neurol.* 2007;14:343–345.
12. Ikeda K, Deguchi K, Touge T, Sasaki I, Tsukaguchi M, Shimamura M, Komatsu E, Takeuchi H, Kuriyama S. Painful legs and moving toes syndrome associated with herpes zoster myelitis. *J Neurol Sci.* 2004;219:147–150.
13. Jabbari B, Molloy FM, Erickson M, Floeter MK. Bilateral painful hand-moving fingers: electrophysiological assessment of the central nervous system oscillator. *Mov Disord.* 2000;15:1259–1263.
14. Mitsumoto H, Levin KH, Wilbourn AJ, Chou SM. Hypertrophic mononeuritis clinically presenting with painful legs and moving toes. *Muscle Nerve.* 1990;13:215–221.
15. Montagna P, Cirignotta F, Sacquegna T, Martinelli P, Ambrosetto G, Lugaresi E. "Painful legs and moving toes" associated with polyneuropathy. *J Neurol Neurosurg Psychiatry.* 1983;46:399–403.
16. Mosek A, Rabey JM, Kushnir M, Korczyn AD. Painful calf, moving foot. *Mov Disord.* 1996;11:339–340.
17. Nathan PW. Painful legs and moving toes: evidence on the site of the lesion. *J Neurol Neurosurg Psychiatry.* 1978;41:934–939.
18. Okamoto S, Takegami T, Mano T. [Peculiar involuntary movement of the toes associated with discomfort of the foot, a case of so-called "painful legs and moving toes"] [in Japanese]. *Rinsho Shinkeigaku.* 1974;14:829–834.
19. Okuda Y, Suzuki K, Kitajima T, Masuda R, Asai T. Lumbar epidural block for 'painful legs and moving toes' syndrome: a report of three cases. *Pain.* 1998;78:145–147.
20. Papapetropoulos S, Argyriou AA. Painful limbs/moving extremities. *Acta Neurol Scand.* 2008;117:224–230.
21. Papapetropoulos S, Singer C. Painless legs moving toes in a patient with Wilson's disease. *Mov Disord.* 2006;21:579–580.
22. Pitagoras de Mattos J, Oliveira M, André C. Painful legs and moving toes associated with neuropathy in HIV-infected patients. *Mov Disord.* 1999;14:1053–1054.
23. Pla ME, Dillingham TR, Spellman NT, Colon E, Jabbari B. Painful legs and moving toes associates with tarsal tunnel syndrome and accessory soleus muscle. *Mov Disord.* 1996;11:82–86.
24. Sahashi K, Tsuchiya I, Iwase S, Ibi T, Mano T. [Clinical analyses on moving toes in "painful legs and moving toes"] [in Japanese]. *Rinsho Shinkeigaku.* 1989;29:849–853.
25. Sanders P, Waddy HM, Thompson PD. An "annoying" foot: unilateral painful legs and moving toes syndrome. *Pain.* 1999;82:103–104.
26. Sandyk R. Neuroleptic-induced "painful legs and moving toes" syndrome: successful treatment with clonazepam and baclofen. *Ital J Neurol Sci.* 1990;11:573–576.
27. Schoenen J, Gonce M, Delwaide PJ. Painful legs and moving toes: a syndrome with different physiopathologic mechanisms. *Neurology.* 1984;34:1108–1112.
28. Schott GD. "Painful legs and moving toes": the role of trauma. *J Neurol Neurosurg Psychiatry.* 1981;44:344–346.
29. Schwingenschuh P, Bhatia KP. Painful moving tongue in a patient with the painful legs moving toes syndrome. *Mov Disord.* 2008;23:1324–1325.
30. Shime N, Sugimoto E. Lumbar sympathetic ganglion block in a patient with painful legs and moving toes syndrome. *Anesth Analg.* 1998;86:1056–1057.
31. Singer C, Papapetropoulos S. A case of painless arms/moving fingers responsive to botulinum toxin a injections. *Parkinsonism Relat Disord.* 2007;13:55–56.
32. Spillane JD, Nathan PW, Kelly RE, Marsden CD. Painful legs and moving toes. *Brain.* 1971;94:541–556.
33. Spurling RG, Scoville WB. Lateral rupture of the cervical intervertebral discs: a common cause of shoulder and arm pain. *Surg Gynecol Obstet.* 1944;78:350–358.
34. Sudo H, Ito M, Minami A. A moving middle finger. *Lancet.* 2003;361:2202.
35. Supiot F, Gazagnes MD, Bleic SA, Zegers de Beyl D. Painful arm and moving fingers: clinical features of four new cases. *Mov Disord.* 2002;17:616–618.
36. Takahashi H, Saitoh C, Iwata O, Nanbu T, Takada S, Morita S. Epidural spinal cord stimulation for the treatment of painful legs and moving toes syndrome. *Pain.* 2002;96:343–345.
37. Touge T, Ishibashi T, Kamoda M, Tsukaguchi M, Takeuchi H. ["Painful legs and moving toes" and muscle cramps spreading to the bilateral legs in a patient with alcoholic polyneuropathy] [in Japanese]. *Rinsho Shinkeigaku.* 1998;38:762–766.
38. Uchihara T, Ichikawa T, Furukawa T, Tsukagoshi H. Myoclonus with burning sensation in legs that remits with sympathetic blockade. *J Neurol Sci.* 1990;100:161–164.
39. Verhagen WI, Horstink MW, Notermans SL. Painful arm and moving fingers. *J Neurol Neurosurg Psychiatry.* 1985;48:384–385.
40. Villarejo A, Porta-Etessam J, Camacho A, González De La Aleja J, Martínez-Salio A, Penas M. Gabapentin for painful legs and moving toes syndrome. *Eur Neurol.* 2004;51:180–181.
41. Walters AS, Hening WA, Shah SK, Chokroverty S. Painless legs and moving toes: a syndrome related to painful legs and moving toes? *Mov Disord.* 1993;8:377–379.
42. Wulff CH. Painful legs and moving toes: a report of 3 cases with neurophysiological studies. *Acta Neurol Scand.* 1982;66:283–287.