MYELOPATHY HAND

NEW CLINICAL SIGNS OF CERVICAL CORD DAMAGE

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A characteristic dysfunction of the hand has been observed in various cervical spinal disorders when there is involvement of the spinal cord. There is loss of power of adduction and extension of the ulnar two or three fingers and an inability to grip and release rapidly with these fingers. These changes have been termed "myelopathy hand" and appear to be due to pyramidal tract involvement. The characteristic nature of the signs permit the distinction between myelopathy and changes due to nerve root or peripheral nerve disorder. The clinical significance of these signs has been assessed against other tests and their value in management is discussed.

Clumsiness of the hand is one of the most common complaints in patients with spinal cord disorders such as myelopathy secondary to cervical spondylosis. Impaired grip may be seen as well as slow, unskilled hand and finger movements. Yet few reports have been published on the characteristic dysfunctions of the hand or fingers in cervical spinal cord disease (Brain and Wilkinson 1967; Baily 1974). This may be due to the difficulty of distinguishing between dysfunction caused by cord damage and that caused by radicular involvement.

In a prospective study of cervical spondylotic myelopathy, we commonly observed a characteristic abnormality in the affected hand of patients with advanced disease (Ono et al. 1977, 1982). There was inability to extend the ulnar two or three fingers, despite relatively well preserved function of the wrist, thumb and index finger. Rapid extension of the fingers was impossible even in patients with less advanced disease. These abnormalities were generally accompanied by an exaggerated triceps reflex, positive Wartenberg's and Hoffmann's reflexes and long tract signs, such as a spastic gait and hyper-reflexia in the lower limbs. We found that the earliest change was inability to adduct the little finger; this progressed to affect the ring and middle fingers. As the disease became more severe this loss of adduction in the ulnar fingers was followed by the inability to extend them.

We have surveyed the prevalence of this "myelopathy hand" in various disorders of the cervical spine and cord in an attempt to discover the responsible lesion and to assess its diagnostic significance.

PATIENTS AND METHODS

A total of 127 patients with cervical spine or cord disorders were examined in this survey. Of these, 79 had evidence of myelopathy and 48 had radiculopathy. Details of the patients are given in Table I.

The diagnosis of "myelopathy hand". The diagnosis was made by performaning two simple tests:

1. *The finger escape sign - deficient adduction and/or extension of the ulnar two or three fingers.* The patient is asked to present the arms with fingers forward and palms down. In this position the little finger tends to lie in slight abduction and cannot be held in adduction for more than 30 seconds, whereas it can be abducted or be opposed to the thumb. In more advanced cases, a similar tendency is seen in the ring finger and at rest the two spaces between the ulnar three fingers are both clearly increased. In addition, at this stage, full extension at the interphalangeal joints of the ulnar fingers is lost. As disability advances the ulnar three fingers become significantly flexed at the metacarpophalangeal joint so that the patient can manipulate objects freely only with the thumb and the index finger.

In each patient it is important to determine whether active flexion and extension of the wrist is possible so as to exclude cases of motor neuron disease or of peripheral nerve involvement. On the results of these tests, we were

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Table I. Diagnosis, aetiology and incidence of myelopathy hand in 127 patients

Diagnosis and aetiology	Number of patients	Incidence of myelopathy hand (*per cent*)
Myelopathy		
Cervical spondylosis	31	*90.3*
Cervical disc protrusion	14	~~11.4~~
Ossification of the posterior longitudinal ligament (OPLL)	27	*92.6*
Cord tumour	4	*100·0*
Miscellaneous, e.g. atlanto-axial dislocation in rheumatoid arthritis	3	*67·0*
Radiculopathy (secondary to spondylosis in most cases)	48	*0**

* The finger-escape sign alone was present in 15%

able to classify finger disability into five grades, as described in Table II and illustrated in Figures 1 and 2.

2. *Inability to grip and release rapidly with the fingers.* The patient is asked to grip and release with the fingers as rapidly as possible, with the arm in the same position as for the first test (Fig. 3). The number of complete cycles of movement within 10 seconds is counted. Difficult, slow and incomplete finger extension was remarkable in advanced cases; exaggerated wrist flexion with attempted finger extension and exaggerated wrist extension with finger flexion were often seen. This was considered to be caused by a failure of synergy between the wrist and the fingers. Normal adults can perform such rapid grip and release movements more than 20 times in 10 seconds.

The lesion responsible for myelopathy hand. The incidence of "myelopathy hand" was studied in several groups. Patients with spastic lower limbs were compared with those without such spasticity. Most of the latter group suffered from radiculopathy secondary to cervical disc disease or spondylosis. Patients were also examined to determine correlation of myelopathy hand with spasticity of the hand and with lesions at various segmental levels in the cervical cord. An attempt was made to correlate the severity of myelopathy hand with efficiency in the activities of daily living and with walking ability, in order to determine whether it was related to any disorder of the long tracts of the spinal cord.

Table II. Grading of the finger-escape sign

Grade	Fingers	Deficiency
0	All	None
1	Little	Unable to hold adduction
2	Little or little and ring	Unable to assume adduction
3	Little and ring	Unable to assume adduction or full extension
4	Little, ring and middle	Unable to assume adduction or full extension

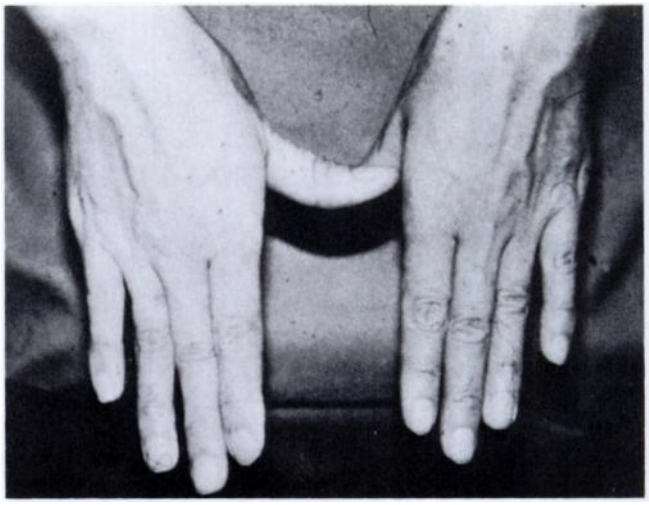

Fig. 1

Fig. 2

The finger-escape sign: lack of adduction and extension of the ulnar fingers (see text and Table II). Figure 1 - Grade 2; Figure 2 - Grade 4.

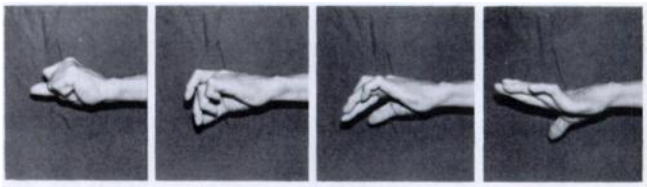

Fig. 3

The grip-and-release test. The number of repeated actions within 10 seconds is recorded. The normal result is 20 or more.

Pathology and neuroradiology. A few patients with advanced myelopathy hand secondary to cervical spondylosis have come to autopsy (Ono et al. 1977). Marked demyelination, particularly in the lateral and the posterior columns, and infarction of the grey matter were seen in cases with severe compression of the cervical cord, as assessed by the anteroposterior/width ratio. Involvement of the pyramidal tract was commonly seen and was dependent upon the severity of compression.

The shape and the size of the cervical cord were investigated by CT myelography at the affected level.

Table III. Relation between spastic paresis and myelopathy hand in 127 patients

Test for spasticity	Result	Number	Myelopathy hand diagnosed: Number	Myelopathy hand diagnosed: *Per cent of group*
Spastic gait and exaggerated patellar tendon reflex	Positive	77	67	*87.0*
	Negative	50*	2	*4.0*
Pathological hand reflex	Positive	71	63	*88.7*
	Negative	56*	6	*10.7*

* Included 48 cases of cervical radiculopathy

Recently available high resolution CT gave an exact image of the cervical cord, so that its cross-sectional area at the level of maximum compression could be measured.

RESULTS

The incidence of myelopathy hand. Table I shows the incidence in each of the diagnostic groups of patients who had difficulty with little-finger adduction (Grade 1 finger-escape sign), and could achieve less than 20 repetitions of grip and release of the hand within 10 seconds with abnormal synergy at the wrist. Irrespective of the diagnosis, those patients with long tract signs, such as spastic gait or exaggerated tendon reflexes in the legs, showed a high prevalence of myelopathy hand as compared with those without spasticity, who were usually complaining of neck, shoulder or arm pain. Most patients with cervical spondylosis showed no manifestation of myelopathy hand no matter how severe their radicular pain, but a Grade 1 finger-escape sign was occasionally encountered in patients with arm pain and muscle weakness secondary to cervical radiculopathy. These patients did not, however, have slowness of grip and release.

The responsible lesion. There was a positive correlation between the signs of myelopathy hand and spasticity defined by the presence of exaggerated Wartenberg's finger reflex and Hoffman's reflex (Table III). No correlation was found between myelopathy hand and cervical cord involvement at any particular level (Table IV). Patients suffering from high cord compression due to an atlanto-axial lesion presented myelopathy hand as frequently as those patients with a lesion lower in the cervical spine. However, positive signs of myelopathy hand were rarely seen in paretic patients with cord involvement at C6/7 or below.

Correlation between myelopathy hand and performance in patients with spastic paresis. The activities of daily living were scored according to the grading scale proposed by the Japanese Orthopaedic Association. This scale is based on the assessment of motor, sensory and sphincter function (Table V) and a normal patient scores a total of 17 points. Good correlation of the total score with the grade of myelopathy hand, as assessed by the finger-escape sign, is shown in Figure 4, and there was also good correlation with the score for motor dysfunction of the lower limbs. Similar correlations were shown for the grip and release test (Fig. 5).

Table IV. Relation between the segmental level of cervical cord damage and the incidence of a positive finger-escape sign in 34 patients with single level compression

Level	Number of patients	Percentage with positive sign
C1/2	5	*80*
C3/4	10	*80*
C4/5	7	*43*
C5/6	9	*100*
C6/7	3	*0*

These results showed that the grade of myelopathy hand reflected performance, and that the correlation with lower limb dysfunction meant that myelopathy hand could be used as an indication of the function of the cervical spinal cord. Furthermore, a positive finger-escape sign and inability to repeat rapid grip and release can be inferred to indicate involvement of the pyramidal tracts.

Neuroradiology and pathology. In a number of patients with prolapsed discs or severe spondylosis, the degree of cord compression, as shown by CT myelography, correlated well with the existence and grade of myelopathy hand. This correlation with the remaining cross-

Table V. An assessment scale for disability due to cervical myelopathy (Japanese Orthopaedic Association)*

I. *Motor dysfunction of the upper extremity*	
Unable to feed oneself	0
Unable to handle chopsticks, able to eat with a spoon	1
Able to handle chopsticks with much difficulty	2
Able to handle chopsticks with slight difficulty	3
None	4
II. *Motor dysfunction of the lower extremity*	
Unable to walk	0
Can walk on flat floor with walking aid	1
Can walk up and/or down stairs with handrail	2
Lack of stability and smooth gait	3
None	4
III. *Sensory deficit*	
Upper extremity	
Severe sensory loss or pain	0
Mild sensory loss	1
None	2
Lower extremity	0–2
Trunk	0–2
IV. *Sphincter dysfunction*	
Unable to void	0
Marked difficulty in micturition (retention)	1
Difficulty in micturition (frequency, hesitation)	2
None	3

* A normal patient scores 17 points

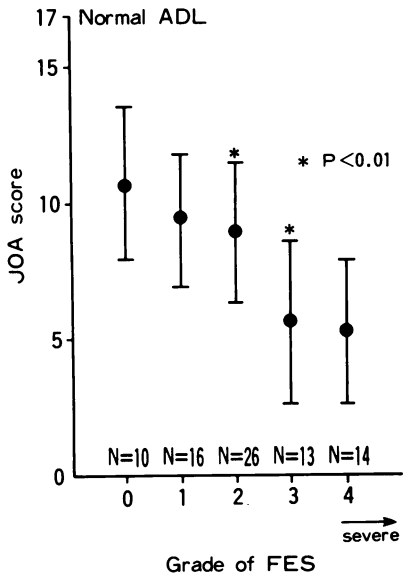

Fig. 4

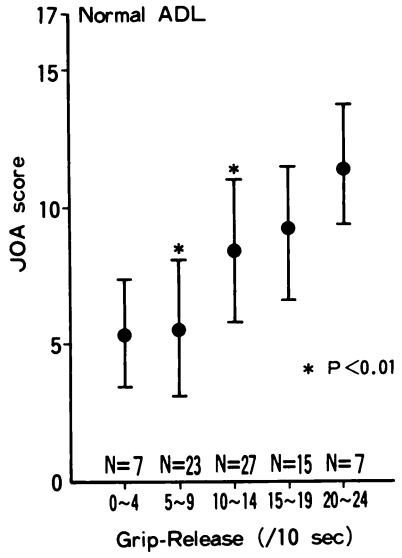

Fig. 5

To show the relation between myelopathy hand and the activities of daily living (ADL) according to the score on the scale of the Japanese Orthopaedic Association (Table V). Figure 4 - Finger-escape sign (FES). Figure 5 - Grip-and-release test.

sectional area is shown in Figure 6. Grade 4 myelopathy hand, the severest form, was usually seen in patients with compression such that the anteroposterior depth of the cord was less than one-third of the lateral width.

Pathological investigation became possible in a few cases with severe grades of myelopathy hand and showed marked diffuse demyelination of the lateral column of white matter including the pyramidal tract (Figs 7 to 9). The lesion which corresponded to myelopathy hand appeared to be degeneration of the corticospinal tract, since the anterior horn of grey matter at C7, C8 and T1 levels was generally well preserved.

Sensory changes. A distinct type and distribution of sensory deficiency, with marked insensitivity to pin-prick, was found in patients with myelopathy hand. Hypalgesia and even analgesia often extended to the wrist and the dorsum of the forearm and was not of dermatome distribution. Lack of pain sensation seemed to depend on the severity of myelopathy or compression of the spinal cord, irrespective of the segmental level involved. Insensitivity to pain was greater in the more peripheral areas and loss of pain sensation was also found on the lateral aspects of the lower legs and feet. This pattern of sensory deficit was seen in 75% of the patients with myelopathy hand.

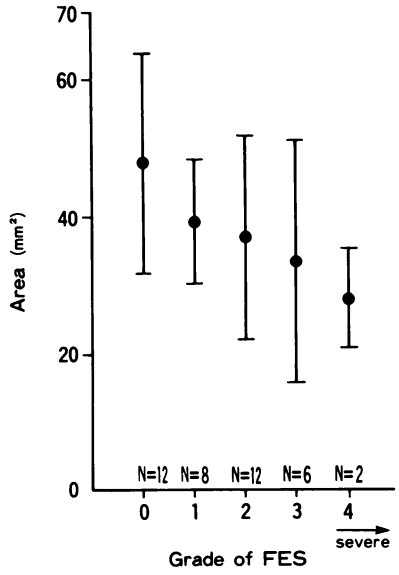

Fig. 6

The relation between the cross-sectional area of the cervical spinal cord at the level of maximum compression on CT myelography and the grade of finger-escape sign.

DISCUSSION

Limb spasticity is one of the most common neurological findings in various disorders of the cervical spine and cord, confirming the frequent involvement of the pyramidal tract. But studies of the clinical manifestations of pyramidal tract involvement in the hand are surprisingly rare, in spite of the fact that clumsiness of the hands is common in such patients. Myelopathy hand, as defined, is a sensitive and specific sign of pyramidal tract involvement and hence provides an objective test. The clinical significance of myelopathy hand is considerable:

1. Cervical cord involvement can be identified by its presence.

Fig. 7

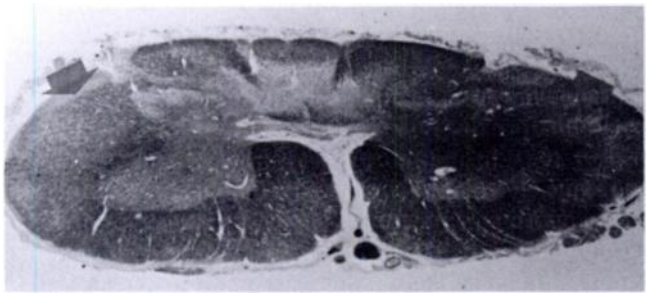

Fig. 8

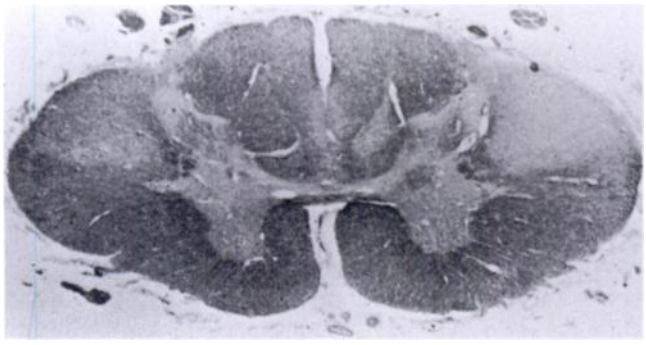

Fig. 9

Cross-sections of the spinal cord from a patient with severe myelopathy hand, to show flattening of the cord and degeneration of the lateral corticospinal tract. From above down, the levels are C4, C6 and T1.

2. In cases of cervical spondylosis, where radicular complaints may coexist with myelopathy, the presence of signs of myelopathy hand indicates significant cord compression.

3. Myelopathy hand is useful in patients with various diseases at the craniocervical junction, in which there may be few objective symptoms or signs of cord involvement except for spasticity. In fact it indicates a disorder of the upper rather than the lower cervical spine.

4. In patients with marked spastic paraplegia and no signs of myelopathy hand, the responsible lesion is likely to be at or below the cervicodorsal junction.

5. The grade of myelopathy hand may help indicate the viability of the spinal cord and predict the reversibility of impaired function, since worsening of the grade indicates damage to the centrally located pyramidal tract. The deeper the damage, the less likely is it to be reversible, but further study is needed to verify this statement.

6. The signs of myelopathy hand may be useful to discriminate between compression myelopathy and psychosomatic disorders or systemic cord degeneration but, again, more experience is necessary to verify this.

Differential diagnosis. Grades 1 and 2 of myelopathy hand resemble the digiti quinti sign in hemiparesis reported by Alter (1973). This means that the cranial nerves should be examined carefully for evidence of abnormality if such a disorder is suspected. However, the characteristic deficits of pain sensation in the hands and legs are a distinctive feature in patients suffering from compression myelopathy unrelated to brain damage. Ulnar nerve palsy can be excluded by testing the power of abduction of the little finger and of opposition to the thumb. In patients with Grade 1 or 2 myelopathy hand, abduction and opposition of the little finger are usually possible. In Grade 3 or 4 myelopathy hand, the little and/or ring finger can be actively flexed at the metacarpophalangeal joints, which is not possible in ulnar palsy.

Insufficiency of finger adduction and/or extension starts and is greatest in the ulnar fingers. This could be explained by assuming that it is related to the cortical representation of each finger, which is greater for the thumb and index than for the little or ring fingers (Penfield and Rasmussen 1950). If this inequality continues distally, affecting the number of motor neurons in the pyramidal tract at cervical level, then the well innervated thumb and index finger are likely to show much less motor deficiency as a result of pyramidal tract involvement than the less well innervated little and ring fingers. The volar interosseous muscle between the fourth and fifth metacarpals is known to be poorly innervated and therefore susceptible to insufficiency. This is a possible explanation for the escape of the index finger and the early appearance of the digiti quinti sign in cases of pyramidal tract involvement.

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