Thoracic Myelopathy in the Japanese: 
Epidemiological and Clinical Observations on 
the Cases in Miyagi Prefecture

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myelopathy for 7 years in a northeastern prefecture (population, 2.26 million) and 
surrounding areas were reviewed. Eighty-one residents in the prefecture were 
operated on. The annual operation rate per one million people was 5.1. The rate 
corresponded to 9% of that reported for cervical myelopathy in the same prefecture. 
The mean age at operation was 55 years. Fifty-five patients (68%) were 
males and 26 (32%), female. Twenty-eight % of the patients had preoperative periods longer than two years, and 23% had severe disabilities. Anterior decompression was performed in 27%, posterior decompression in the others. The 
postoperative recovery rate averaged 48%. The lowest rate was 31% in patients 
with an preoperative duration of more than 2 years (p<0.05). Sixty-four % of the 
patients had ossification of the ligamentum flavum; 20%, posterior spur; 19%, 
disc herniation; 16%, ossification of the posterior longitudinal ligament; 1%, 
calcification of the ligamentum flavum; 1%, degenerative spondylolisthesis. 
Seventy-nine % had one of the above spinal factors and 21% had two. ——— 
Thoracic myelopathy; epidemiology; degenerative spine

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Thoracic myelopathy is produced by various degenerative changes of the 
spine as follows: disc herniation (Otani et al. 1988; Stillerman and Weiss 1991), 
ossification of the posterior longitudinal ligament (OPLL)( Yonenobu et al. 1987), 
ossification of the ligamentum flavum (OLF) (Okada et al. 1991). Thoracic 
myelopathy, the symptomatology of which is not well recognized by general 
physicians or even by orthopaedists or neurosurgeons, was often overlooked or 
missed as lumbar spinal disorders (Kurakami et al. 1988). In addition, it 
was fairly difficult to detect the pathological factors of the spine contributing to

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thoracic myelopathy before the advent of CT scanning and MR imaging (Kokubun et al. 1987; Sato et al. 1997a). For example, OLF could not be ascertained correctly using a lateral x-ray film because OLF is located posterolaterally in the spinal canal (Saiki et al. 1981). The number of operations has recently increased as the result of improvements in diagnostic imaging techniques, the spread of spinal surgery and an increase in patients unwilling to tolerate their paraparesis. However, there have been no epidemiological studies of thoracic myelopathy. In this study, we investigated the characteristics of thoracic myelopathy among residents of northeastern Japan in terms of the annual operation rate for a given population, clinical aspects and relative contribution of various pathologic factors of the spine to the production of symptoms.

Materials and Methods

Spine surgery cases at orthopaedic departments of hospitals in Miyagi Prefecture (population, 2.26 million in 1994) and surrounding areas have been registered since 1988. All the departments in Miyagi Prefecture are affiliated with the Department of Orthopaedic Surgery, Tohoku University School of Medicine. Between 1988 and 1994, 8510 patients were operated on for spinal lesions. Of these, 140 (2%) had thoracic myelopathy due to degenerative processes of the spine, and these were the subjects of the current study on the prevalence of operation for thoracic myelopathy.

Patients who were residents of Miyagi Prefecture were reviewed to outline the clinical aspects of thoracic myelopathy. Their plain lateral radiographs, tomograms, CT scans and MR images were reviewed with operative findings to elucidate the contributions of various spinal factors to the production of symptoms.

For assessment of the neurological status, the Japanese Orthopaedic Association scoring system for cervical myelopathy (Japanese Orthopaedic Association 1994), in which a full score is 17 points, was modified. Dexterity of the hands (4 points) and sensory impairment of the upper extremities (2 points) being excluded from the original scoring system, a normal score in the modified evaluation was 11 points. The recovery rate was calculated as follows;

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\text{postoperative score-preoperative score)/(11-preoperative score)} \times 100\%.
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Results

Annual operation rate

Of the 140 registered patients with thoracic myelopathy during the study period, 81 (58%) were residents of Miyagi Prefecture, and all of these patients had surgical treatment within the prefecture. Twenty patients (14%) from other prefectures visited departments in Miyagi Prefecture, and 39 (28%) were operated on in their own prefectures. Accordingly, the annual rate of operation for thoracic myelopathy per one million people in Miyagi Prefecture was 5.1.
Clinical outline

Of the 81 Miyagi residents, 55 (68%) were male and 26 (32%) were female. The age at operation averaged 55 years (range, 32 to 83 years). Most of the patients were in their sixth (37%) or seventh decade (32%) of life.

The most common initial symptom was tingling or numbness in the lower extremities, which was reported by 53% of the patients. Other common initial symptoms were gait disturbances such as tripping or spastic gait (34%), weakness in the lower extremities (15%), pain in the lower extremities (11%), back pain (10%), intermittent claudication (6%), and urinary disturbance (3%).

The preoperative duration of symptoms was less than 6 months for 31% of the patients, 6 months to one year for 22%, 1 to 2 years for 16%, more than 2 years for 28%, and unknown for 2%.

The preoperative neurological score averaged 5.0 (range, 0 to 9). Twenty-three percent of the patients were severely impaired with a score of 3 or lower, 51% were moderately impaired with a score of 4 to 6, 25% were slightly impaired with a score of 7 to 9, and the score for 1% was unknown. Most of the severely impaired patients could not walk without a cane or assistance.

Anterior decompression and fusion through a transthoracic approach was performed in 20 patients (25%): 19 had a single-disc-level operation, and one had a two-disc-level operation. Anterior decompression through a diagonal anterior and posterior approach (Kokubun et al. 1991) was performed in 2 patients (2%): One had a two-disc-level operation, and the other had a 5-disc-level operation. Posterior decompression was done in 59 patients (73%). The number of decompressed disc levels ranged from 1 to 7 with a mean of 2. The method used was bilateral open-door laminectomy (Kaneda et al. 1977; Sato and Kokubun 1983) in 37 patients (63%), en-bloc laminectomy (Tanaka et al. 1980) in 12 (20%), hemilaminectomy in 6 (10%), and fenestration (Sato et al. 1996) in 4 (7%).

Symptoms improved after surgery in 68 patients (84%). At the last follow-up an average of 14 months (range, 3 months to 5 years) after operation, the modified Japanese Orthopaedic Association score averaged 8.0 (range, 0 to 11). The improvement in score averaged 3.0 (range, −3 to 10), and the recovery rate averaged 48% (range, −38% to 100%).

The average recovery rate was 54% in patients with a preoperative duration of less than 6 months; 57% in those with 6 months to one year; 61% in those with 1 to 2 years; and 31% in those with a duration of more than 2 years (Fig. 1). The rate in patients with a duration of more than 2 years was significantly lower than that in the others (Fisher's method, p < 0.05). The average recovery rate was 43% in patients severely impaired, 52% in those moderately impaired, and 47% in those slightly impaired.
Spinal factors leading to thoracic myelopathy

Of the 81 patients, 64 (79%) had one of the following six pathologic factors: OLF, posterior spur, disc herniation, OPLL, spondylolisthesis and calcification of the ligamentum flavum (CLF). The remaining 17 patients (21%) had two of the factors.

Ossification of the ligamentum flavum (OLF)

Fifty-two patients (64%) had OLF. The extent of OLF ranged from one to 6 disc levels (average, two disc levels). Twenty-seven (52%) of them had a single-disc lesion. OLF was most prevalent in the lower thoracic spine (Fig. 2). Thirty-seven patients (71%) had OLF alone. Nine patients (17%) had OPLL as a concurrent factor: eight at the same disc levels or within the range of the OLF, and one at a different disc level. Five (10%) had a posterior spur: three at the same disc level and two at an adjacent disc level. One (2%) had disc herniation at the same level. Six patients (12%) had ossification of the dura coexisting with OLF (Fig. 3A, B).

Posterior spur

Sixteen patients (20%) had posterior spurs. Twelve of them (75%) had a
single-disc level lesion. The posterior spurs were distributed in the lower thoracic spine (Fig. 2). Ten patients (63%) had posterior spurs alone. Five patients (31%) had OLF and one patient (6%) had disc herniation as a concurrent factor (Fig. 4A, B).

**Disc herniation**

Fifteen patients (19%) had disc herniation, and all were a single-disc lesions. Disc herniation was distributed in the middle and lower thoracic spine (Fig. 2). Twelve patients (80%) had disc herniation alone. One patient (7%) had OLF as a concurrent factor. The remaining two patients (13%) had OPLL or a posterior spur at an adjacent disc level (Fig. 5A, B).

**Ossification of the posterior longitudinal ligament (OPLL)**

Thirteen patients (16%) had OPLL. The extent of OPLL ranged from one to five disc levels (average, three disc levels). OPLL was more frequently distributed in the middle thoracic spine than in the upper and lower thoracic spines (Fig. 2). One patient had continuous OPLL from the cervical down to the
Fig. 3. Ossification of the ligamentum flavum (OLF).
A, CT scan showing an enlarged type OLF which thickened and enlarged anteromedially. B, CT scan showing a tuberous type OLF which fused at the midline and grew forward.

thoracic spine. Three patients (23%) had OPLL alone. Nine patients (69%) had OLF and one patient (8%) had disc herniation as a concurrent factor (Fig. 6A, B).

Spondylolisthesis and calcification of the ligamentum flavum
One patient (1%) had spondylolisthesis and another (1%) had CLF.

Discussion
Until now, there has been no epidemiological study on the incidence of thoracic myelopathy. In the present study the annual operation rate was 5.1 per one million people in Miyagi Prefecture in the current study. This rate corresponds to 9% of that for cervical myelopathy in the same prefecture, i.e., 5.7 operations per 100,000 people (Kokubun et al. 1996). Of course, some patients from Miyagi Prefecture may have had surgical treatment at hospitals far from the prefecture. But this number can be expected to have been quite small since none of the Miyagi patients had been operated on in the surrounding areas. Accordingly, the operation rate obtained in the current study can be considered reliable.

It is necessary to include the patients who were treated conservatively for the determination of the true incidence of thoracic myelopathy. Today, however,
compression of the spinal cord and factors contributing to thoracic myelopathy can easily be detected by CT scanning and MR imaging. Further, because thoracic myelopathy does not respond well to conservative treatment (Kaneda et al. 1977), its existence is almost invariably an indication for surgery, without which deterioration occurs. Accordingly, the operation rate in the current study should be close to the incidence of thoracic myelopathy.

The symptoms of thoracic myelopathy in its early stages are generally reflected in the lower extremities (Kurakami et al. 1988). Common initial symptoms in the patients in the current study were tingling or numbness of the lower extremities and gait disturbance such as tripping due to spasticity. Theoretically, these symptoms can be easily distinguished from pain radiating to the lower extremity and intermittent claudication peculiar to lumbar disc herniation and lumbar canal stenosis, respectively. In addition, restricted motion of the lumbar spine, tension signs of lumbar roots and an antalgic scoliosis support the diagnosis of lumbar disc herniation. However, thoracic myelopathy is apt to be misdiagnosed as lumbar lesions which are much more common. Accordingly, careful attention to the patient's description of tingling or numbness of the lower extremities not associated with radiating pain or intermittent claudication is mandatory.

Fig. 4. Posterior spur.  
A, Lateral tomogram showing a marked posterior spur at the T11-12 level.  
B, Sagittal T1-weighted MR image showing the compressed spinal cord and syrinx (*) within it.
Fig. 5. Disc herniation.
A, Sagittal T1 weighted MR image showing an extruded mass at the T11–12 level. B, CT scan after discography showing an extruded mass.

for early diagnosis of thoracic myelopathy.

OLF, posterior spur, disc herniation and OPLL have been individually described as causative components of thoracic myelopathy in the Japanese and English literature (Yonenobu et al. 1987; Otani et al. 1988; Okada et al. 1991; Stillerman and Weiss 1991). The current study, to the best of our knowledge, is the first attempt to analyze these 4 pathological factors and their relative contribution to the production of myelopathy. The involvement of these factors ranged from 16% for OPLL to 64% for OLF. Further, 98% of the patients had at least one of the 4 factors. These findings indicates that imaging diagnosis should be made to determine the presence of these 4 common spinal factors.

OLF inducing thoracic myelopathy has rarely been reported in the English literature except for papers from Japan (Marzluff et al. 1979; Smith and Godersky 1987; Okada et al. 1991). In the current study OLF was the most common spinal factor. OLF, however, is apt to be overlooked on a lateral x-ray film unless foramen are focused on to detect a beak-like or nodular shadow (Saiki et al. 1981). MR image occasionally depicts only partial compression of the spinal cord from posteriorly on its sagittal views, even in severe compression, since OLF is generally located posterolaterally in the spinal canal. Once the involvement of OLF is suspected, it should be confirmed by CT scanning (Sato et al. 1997a).
Fig. 6. Ossifications of the posterior longitudinal ligament (OPLL).
A. Lateral tomogram showing a continuous OPLL from T2 to T6. B. Sagittal T1-weighted MR image showing the spinal cord compressed by a OPLL.

Previously, the operative procedure for thoracic myelopathy was piecemeal laminectomy alone. Transthoracic anterior decompression and fusion (Ransohoff et al. 1969; Otani et al. 1988) was then introduced for thoracic myelopathy due to disc herniation or posterior spur. After the first recognition of OPLL and OLF as contributing factors, bilateral open-door laminectomy (Kaneda et al. 1977; Sato and Kokubun 1983), en bloc laminectomy (Tanaka et al. 1980), transthoracic anterior decompression (Fujimura et al. 1997), transpedicular anterior decompression (Otsuka 1996) and combined anterior and posterior decompression (Tomita et al. 1990; Yonenobu et al. 1990) were developed. From the viewpoint of minimally invasive surgery, transpedicular (Carson et al. 1971) and transversoarthropediculectomy approaches (Lesoin et al. 1986; Sato et al. 1997b) have been recently introduced for disc herniation, and the localized fenestration procedure (Sato et al. 1996) for single-level OLF. From these technical developments the operative procedure is now chosen depending on the kind, size, shape and number of levels of a spinal factor or factors contributing to the myelopathy. The neurological complication rate has been reduced remarkably.

Irrespective of the choice and successful accomplishment of the operative procedure, however, patients with myelopathy with longer preoperative disease
periods show less improvement after surgery. To improve the recovery rate of thoracic myelopathy, operative treatment should be performed as early as possible. Accordingly, efforts should be made to inform physicians and the general public about the symptoms of thoracic myelopathy and the effectiveness of operative treatment.

References