Radiculopathy Due to Focal Spinal Cord Compression

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ABSTRACT. In some patients with radiculopathy, the etiology is not nerve root compression but instead spinal cord compression. We studied the location of compression in 36 patients with radiculopathy. In about 60% of the patients, there was no nerve root compression, but compression of the spinal cord itself was found. We measured the interpedicular distance and the anteroposterior diameter of the spinal canal in patients with radiculopathy or myelopathy, and found no significant differences ($p<0.01$) in the interpedicular distance. The anteroposterior diameter of the spinal canal, however, was significantly wider in the patients with radiculopathy ($p<0.01$).

In the pathogenesis of radiculopathy, low-grade compression of the spinal cord may cause regional compression/friction myelitis that eventually leads to radiculopathy.

Key words: radiculopathy — spinal cord compression — myelitis

Spinal cord compression appears to cause myelopathy and nerve root compression radiculopathy. However, some patients with cord compression fail to show any long tract symptoms, and only have radiculopathy (more correctly, radiculopathy-like symptoms or pseudoradiculopathy). We have found no previous reports describing radiculopathy caused by spinal cord compression.

About half of surgically treated patients with radiculopathy have been shown to have spinal cord compression, and radiculopathy may possibly be caused not only by nerve root compression, but also by cord compression.

PATIENTS AND METHODS

Radiculopathy Group (R-G). Over the 14 years from March 1976 to February 1990, 36 patients with cervical radiculopathy underwent anterior discectomy and fusion at our hospital. This study included patients with radiculopathy who underwent surgery and those treated conservatively were excluded. The group was composed of 27 males and 9 females, ranging in age at the time of operation from 24 to 70 years old (50 years old on the average).

Control Group (C-G). Forty-six patients who recently visited our hospital and diagnosed as having neither radiculopathy nor myelopathy were randomly selected. This group was composed of 20 males and 26 females, ranging in age from 31 to 73 years old (51 years old on the average).

Myelopathy Group (M-G). From among patients who underwent anterior

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cervical discectomy and fusion for myelopathy at our hospital, 71 were randomly selected (51 males and 20 females aged from 32 to 74 years old : 50 years old on the average).

The spinal intervertebral level and the location of compressive pathology in each radiculopathy case were studied mainly by computerized tomography after discography (Disco-CT).

The interpedicular distance and anteroposterior diameter of the cervical spinal canal were measured using anteroposterior and lateral radiographs, respectively.

RESULTS

The number of intervertebral levels treated by discectomy and fusion was one in 27 cases, two in 7 cases, and three in 2 cases. Among these 47 intervertebral levels, the compression was considered to be due to disc herniations (soft disk) in 26 and to posterior osteophytes (hard disc) in 21.

The involved levels were C3/4 in 2, C4/5 in 7, C5/6 in 23, C6/7 in 14, and C7/T1 in 1 patient, with 80% of all of the lesions being situated at C5/6 or C6/7 (Table 1). Of the 26 disc herniations, 12 were situated posterolaterally, 9 paracentrally, and 5 in the central part of the spinal canal. Of the 21 intervertebral levels with posterior osteophytes, 8 were situated in the posterolateral, 6 in the paracentral, and 7 in the central part of the spinal canal (Table 2). In all, 57% of the compressive pathology was situated in the paracentral and central parts of the spinal canal.

TABLE 1. The number of cervical intervertebral levels of disc herniations

	C3-4	C4-5	C5-6	C6-7	C7-T1
Soft disc	0	3	13	9	1
Hard disc	2	4	10	5	0
Total	2	7	23	14	1

TABLE 2. The number of disc herniations according to the location

	posterolateral	paracentral	central
Soft disc	12	9	5
Hard disc	8	6	7
Total	20	15	12

The interpedicular distances at the C5, C6, and C7 levels in the R-G, C-G, and M-G groups are shown in Table 3. There were no significant differences among the three groups ($p<0.01$). As for the anteroposterior diameter of the spinal canal (Table 4), a significant difference ($p<0.01$) was noted between the R-G and M-G groups and between the C-G and M-G groups. There was no significant difference between the R-G and C-G groups ($p < 0.01$), so the A-P diameter in the M-G group was considered to be

narrower than in the R-G and C-G groups.

TABLE 3. Interpedicular Distance
(mm, mean ± SD)

	Radiculopathy	Myelopathy	Control
C5	25.7±1.3	25.2±1.6	25.5±1.6
C6	26.0±1.5	25.4±1.6	25.7±1.5
C7	24.8±1.7	24.2±1.5	24.7±1.6

TABLE 4. Anteroposterior diameter of the spinal canal
(mm, mean ± SD)

	Radiculopathy	Myelopathy	Control
C5	14.0±1.7	12.4±1.0†	14.1±1.1
C6	13.8±1.9	12.5±1.1†	14.1±1.3
C7	13.7±1.4	13.0±1.2†	14.1±1.3

† significance of difference $p<0.01$

ILLUSTRATIVE CASES

Case 1. A 46-year-old man was admitted to our hospital with a chief complaint of pain in the upper right arm. In 1986, the patient first noted muscle atrophy in his upper right arm but did not seek medical attention. Six months before admission, he began to experience paraesthesia in the fingers of the right hand and pain in the upper right arm. On admission in May 1988, he had severe pain in the upper right arm which became worse with extension of the neck. Physical examination showed atrophy of the right deltoid and right biceps muscles. Spurling's test was positive on the right side. Neurological examination indicated right C5 and C8 hypesthesia with right C6-7 paraesthesia with no marked change in any reflex of the upper or lower extremities. Radiographs showed no narrowing of the intervertebral spaces but there was mild anterior osteophyte formation at the C5 and C6 vertebrae. Computerized tomography performed one hour after discography (Disco-CT) showed centrally situated disc herniation in the C5/6 intervertebral space (Fig. 1). Anterior discectomy and fusion were performed and the pain and paraesthesia disappeared postoperatively.

Case 2. A 32-year-old male was admitted to our hospital chiefly complaining of pain in the upper left arm of three months duration. He also noticed paraesthesia in the ulnar side of the left hand. Physical examination showed no atrophy of the muscles. Spurling's and Jackson's tests were both negative. Neurological examination indicated left C7 hypesthesia and no marked changes in reflexes. Radiographs showed a slight narrowing of the C6/7 intervertebral space. Disco-CT showed a disc herniation situated paracentrally in the C6/7 intervertebral space (Fig. 2). Anterior discectomy and fusion were performed with excellent results.

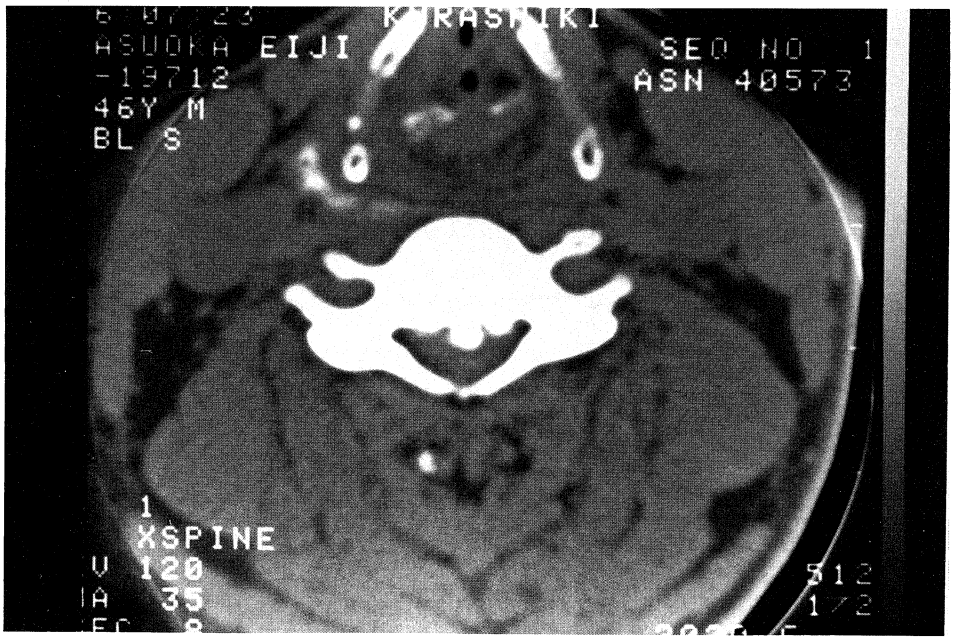

Fig. 1. Computerized tomography performed one hour after discography showing centrally situated disc herniation at the C5/6 intervertebral level

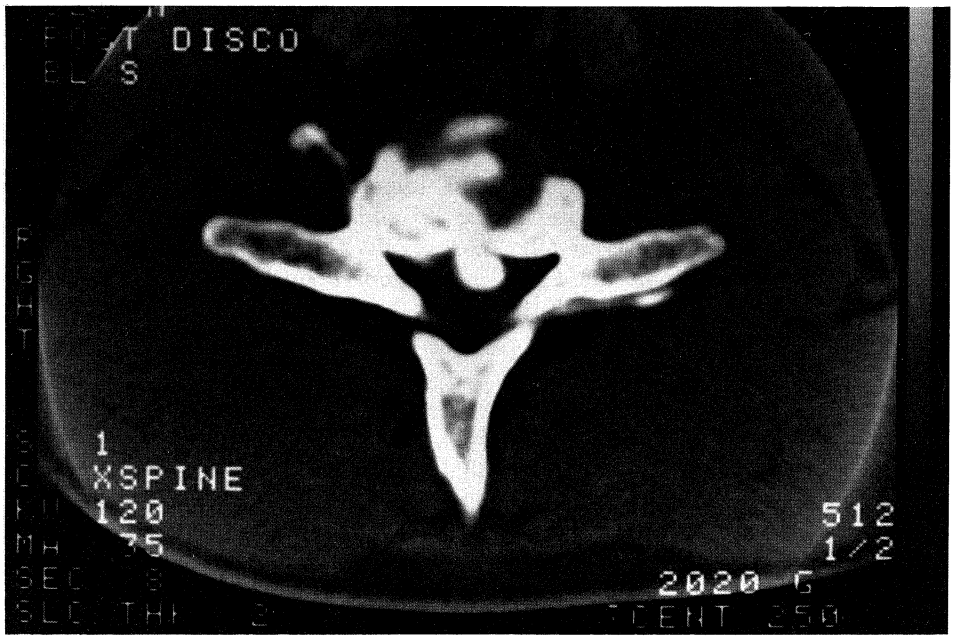

Fig. 2. Disco-CT showing paracentral disc herniation in the C6/7 intervertebral space

DISCUSSION

In 57% of the 36 patients with radiculopathy, compression affected the paracentral or central part of the spinal canal, and there was direct compression of the spinal cord itself. There was a significant difference in the antero-posterior diamater of the spinal canal between the radiculopathy and myelopathy groups ($P<0.01$), while no significant difference was found between the radiculopathy and control groups. Thus, both the location of compressive pathology and the severity of compression may be important factors in the pathogenesis of radiculopathy, myelopathy, and myelo-radiculopathy, with low-grade compression of the spinal cord possibly leading to radiculopathy rather than myelopathy.

Hattori[1] classified myelopathy into three types (Fig. 3), and stated that in Type 1 myelopathy only segmental cord signs may be present in the upper extremities with pain occurring less frequently than in radiculopathy, and that symptoms not only related to the level of the lesion but also to effects on more caudal portions of the spinal cord can also be found, a situation that is perhaps rare in radiculopathy. In our radiculopathy cases, pain was usually the chief complaint, and signs and symptoms were definitely restricted to the unilateral upper extremity. In these respects, the signs and symptoms of our patients were not considered to fall within the category of Type 1 myelopathy as described by Hattori.[1] Regarding the pathogenesis of myelopathy, Hattori[1] maintains that spinal cord injury is the main cause, the extent of which is determined by the distribution of the stresses produced by compression, with circulatory disturbances acting as a secondary factor. This hypothesis, however, would not adequately explain our present findings in radiculopathy patients.

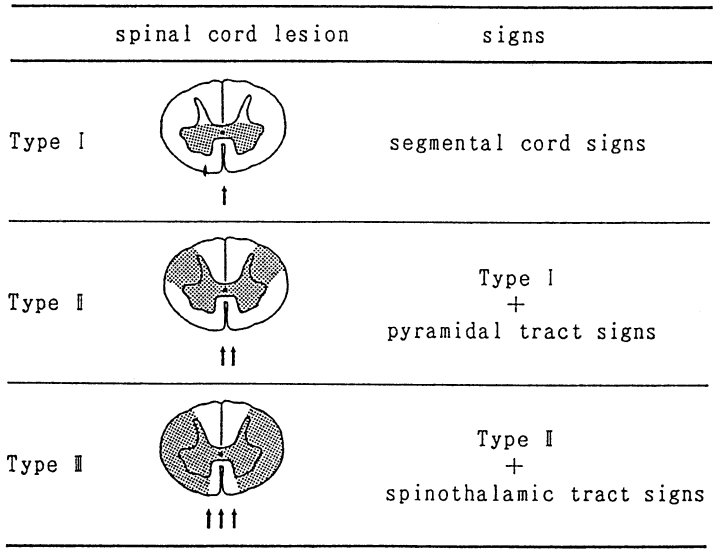

Fig. 3. Classification of myelopathy (Hattori, 1975)

Satoh[2] experimentally showed that dural friction caused local swelling, ecchymosis of the arachnoid, congestion of the spinal cord, and edematous swelling and destruction of the white matter in dogs. These findings appear to be consistent with those of regional compression/friction myelitis. O'Connell,[3] Reid,[4] and Adams[5] have observed that the cervical cord and dura move up and down with flexion and extension of the head and neck. A soft or hard disc compressing the spinal cord may therefore cause the same changes as seen in Satoh's experiment during flexion and extension of the neck. Based on a morphological study of the spinal cord by CT-myelography, Saka[6] stated that radiculopathy might possibly be due not only to nerve root compression, but also to distortion of the cord-root complex. However, he mentioned nothing about the possible pathophysiology.

In summary, we consider that regional compression/friction myelitis resulting from low-grade compression of the spinal cord in the paracentral or central parts of the spinal canal may be one of the causative factors of radiculopathy. Compression at the central or paracentral parts of the spinal canal may perhaps cause either radiculopathy or myelopathy, depending on the intensity of the force applied to the spinal cord.

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