Anterolateral uncoforaminotomy for cervical spondylotic myeloradiculopathy

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Thirty-five patients with cervical spondylotic radiculopathy and myeloradiculopathy had anterolateral uncoforaminotomy. Spondylotic spurs associated with radiculopathy were continuous from the uncovertebral joint to the posterior ridge of the vertebral body in 33 patients and to the posteriorly bulging disc with posterolateral bony spurs in 2 patients. Anterolateral uncoforaminotomy was found safe to remove the continuous type of spur, resulting in decompression of the cord-root complex, which shifted anteriorly after surgery. The outcome was satisfactory in 19 of 20 radiculopathy patients, and in all 15 myeloradiculopathy patients.

Decompression of the cord-root complex is the most important factor in relieving neurologic manifestations of cervical spondylosis.

Osteophytes at cervical uncovertebral joints may cause not only monoradiculopathy, but also disturbed circulation of the radicular artery, a factor contributing to spondylotic cervical myelopathy (Breig et al. 1966). Posterior bony spurs at the vertebral body, combined with posterolateral or lateral spurs, usually compress both the cord and root(s).

In spondylotic myelopathy without cervical canal stenosis, posterior spurs at the vertebral body can be removed by an anterior approach (Epstein and Janin 1983), which, however, leaves posterolateral or lateral spurs even after complete interbody fusion has been achieved.

In the treatment of cervical spondylotic myeloradiculopathy or radiculopathy, anterior surgery may be combined with lateral uncoforaminotomy, which provides for the removal of lateral and posterolateral spurs and relieves the compromised nerve root.

We have analyzed a series of cases subjected to this combined operation to determine whether the indications could be more clearly established.

Patients and methods

Between 1979 and 1986, 20 patients, 15 men and 5 women, with a median age of 51 (44–64) years were operated on for radiculopathy; and 15 patients, 14 men and 1 woman, aged 55 (38–67) years were operated on for myeloradiculopathy (Table 1). Prior to surgery, all the patients had conservative therapy without effect on their progressive neurologic deficits.

In the *monoradiculopathy* group, the average preoperative duration of manifest nerve root compression was 6 months. Unilateral radicular pain and a positive Spurling test (Spurling and Scoville 1944) were observed in all the patients who frequently had relief of pain by shoulder abduction (Davidson et al. 1981). The involved nerve root was C5 in 3 patients, C6 in 12, and C7 in 5.

Radiographically, lateral or posterolateral osteophytes were observed at the uncovertebral joint coincident with the level of the root sign in all 20 patients, 16 of whom had posterior spurring. In 8 of the 20 patients, a bony spur at the opposite side at the same level was not associated with radiculopathy. In all the patients a myelogram showed both anterior and lateral indentations at the involved disc corresponding to the level of the root sign.

In the group of *spondylotic cervical myeloradiculopathy*, all 15 patients had a spastic gait. Sphincter involvement was observed in 5 patients, ataxia in 2, and cervical angina with sphincter involvement and ataxia in 1. All the patients had radicular pain with a positive Spurling test and root signs including muscle weakness and numbness were associated with C5 in 1 patient, C6 in 9, and C7 in 5 patients.

The degree of disability was classified (Table 2) according to a scale modified from Nurick (1972 a, b); 10 of the patients had great difficulties in walking, 3 of whom were unable to walk even with help. A routine

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Table 1. Patients treated with anterolateral uncoforaminotomy. Cases 1–20 had spondylotic radiculopathy, Cases 21–35 had spondylotic myeloradiculopathy

A	B	C	D	E	F	G	H
1	M	48	3		C5	7	–
2	M	48	6		C5	7	–
3	M	53	3		C5	5	–
4	M	44	12		C6	6	–
5	F	53	3		C6	5	–
6	M	64	7		C6	7	–
7	M	49	4		C6	7	–
8	M	48	3		C6	6	
9	F	46	5		C6	7	n
10	F	55	9		C6	7	–
11	M	60	13		C6	7	–
12	F	47	4		C6	6	–
13	M	46	14		C6	7	–
14	M	59	5		C6	2	–
15	M	55	6		C6	3	–
16	M	45	4		C7	8	–
17	M	55	9		C7	7	–
18	M	50	4		C7	8	–
19	M	47	4		C7	7	–
20	F	44	3		C7	7	–
21	M	49	3	a, s, IV	C5	7	II
22	M	52	8	III	C6	8	I
23	M	52	8	III	C6	7	I, n
24	M	65	70	s, III	C6	7	I
25	M	67	37	a, s, V	C6	7	III, n
26	M	52	9	II	C6	3	I
27	F	56	3	II	C6	7	I
28	M	62	38	II	C6	7	I
29	M	61	3	II	C6	7	I
30	M	57	7	I	C6	2	0
31	M	38	3	s, IV	C7	8	0
32	M	40	5	s, V	C7	8	I
33	M	52	6	III	C7	7	I
34	M	59	14	a, s, V	C7	7	I, n
35	M	59	8	IV	C7	5	II

A Case. B Sex. C Age. D Months of symptom. E Grade of myelopathy (Table 2); a ataxia, s sphincter involvement. F Radiculopathy, involved nerve root. G Years follow-up. H Outcome; – no symptoms, n numbness in a finger, I–V grade of myelopathy.

radiographic examination revealed a lateral osteophyte and a posterior spur at the same level as the root sign in all the patients. Further, the two sequent levels were observed to have posterior and lateral spurs in 5 patients, as were the three sequent levels in 3 patients. These osteophytes formed anterior and lateral indentations in myelograms.

The operation

Before surgery an image amplifier and a television monitor are set to facilitate the localization of the target disc level. The operation consists of four steps (Figure 1).

Table 2. Degree of disability associated with cervical spondylotic myelopathy (Nurick 1972 a, b) in 15 patients

		Number of patients	
		Pre-operative	Follow-up
Grade 0	No evidence of spinal cord disease	0	2
Grade I	Symptoms of spinal cord disease, but no difficulty in walking	1	10
Grade II	Slight difficulty in walking	4	2
Grade III	Difficulty in walking that was not so severe as to require someone else's help to walk	4	1
Grade IV	Able to walk only with someone else's help, or with the aid of a frame	3	0
Grade V	Chair-bound or bedridden	3	0

1) Anterior discectomy. Using the anterior approach, the intervertebral disc and posterior bony spur are removed to decompress the dural sac. In this procedure the posterior longitudinal ligament should be excised to expose the cervical cord, which is shifted anteriorly.

2) Transversectomy. After retracting the detached longus capitis and longus colli muscles medially, the anterior rim and lateral border of the costotransverse bar are resected. When the anterior rim is removed, care should be taken not to injure the underlying anterior ramus of the nerve root. After removal of the anterior rim of the transverse foramen, the vertebral artery can be freed from the surrounding connective tissue.

3) Uncoforaminotomy. After retracting the vertebral artery laterally, the intervertebral foramen is identified by following the anterior ramus of the nerve root to its exit from the cervical spine. The next step is to remove enough bony spurs from the lateral, posterolateral, or intraforaminal parts for the nerve root and dural canal to be shifted anteriorly. This is the most important procedure in decompressing the cord-root complex.

4) Anterior interbody fusion. After hemostasis is completed, interbody grafting is performed.

When posterior spurs of sequent levels are thought to be responsible for the myelopathy, the vertebral body between these levels is removed together with the posterior spurs. After decompression by this technique, an anterior bone graft is inserted.

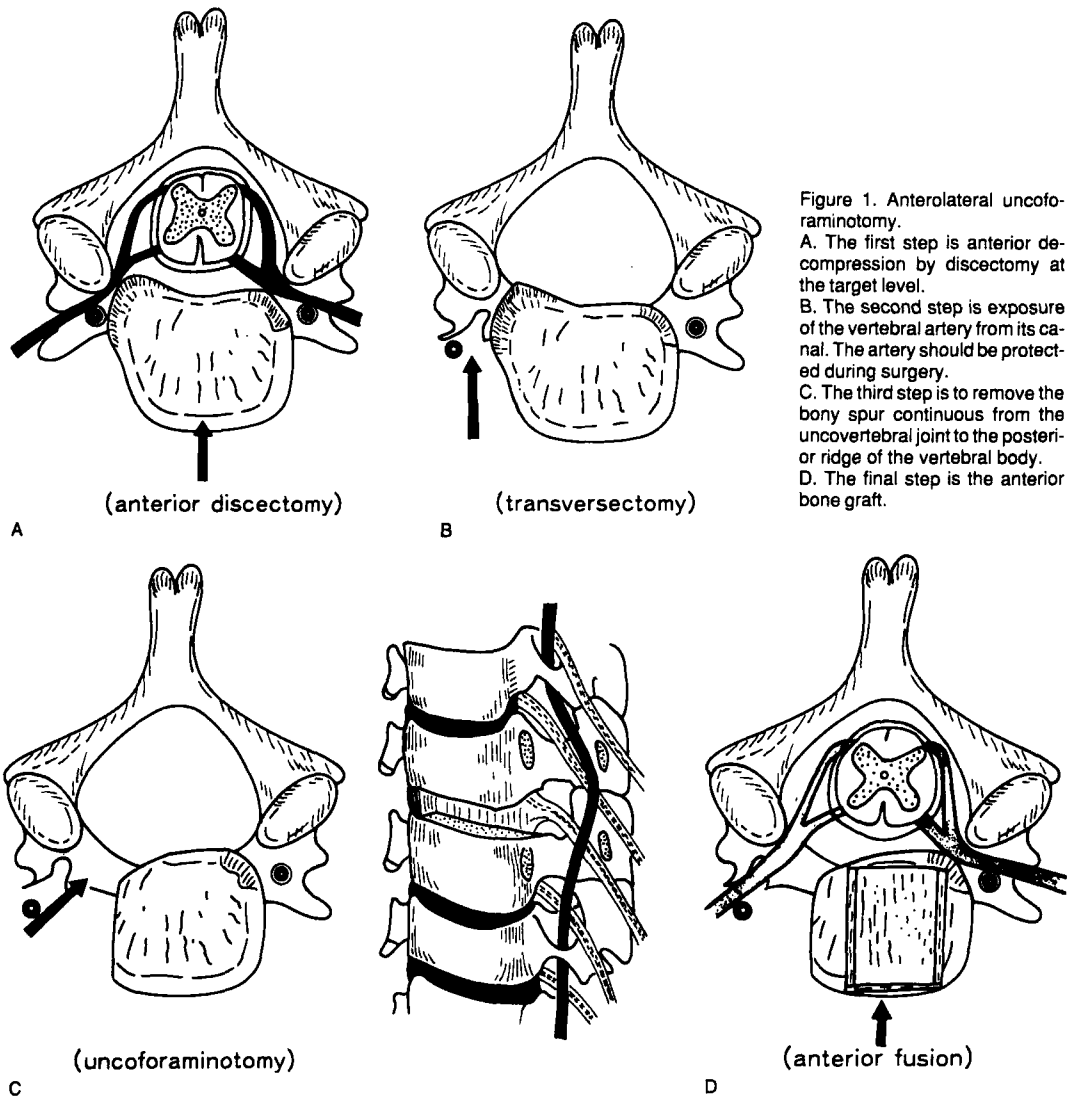


Figure 1. Anterolateral uncoforaminotomy.
A. The first step is anterior decompression by discectomy at the target level.
B. The second step is exposure of the vertebral artery from its canal. The artery should be protected during surgery.
C. The third step is to remove the bony spur continuous from the uncovertebral joint to the posterior ridge of the vertebral body.
D. The final step is the anterior bone graft.

In the radiculopathy group, the C5 nerve root was compromised by lateral or posterolateral spurs, and was decompressed in 3 patients, the C6 nerve root in 12, and the C7 nerve root in 5 patients. Of the 20 patients, posterior spondylotic spurs existed at the involved level, connected with lateral and posterolateral spurs in 18 patients; the 2 other patients had a disc bulging towards the dura with posterolateral spurring. In the first step of the procedure, the posterior spur was removed, followed by uncoforaminotomy, resulting in anterior shifting of the cord-root complex. In 1 patient, marked adhesion was observed between a nerve root and bony spur. In 3 patients, a lateral bony spur was found compressing not only the nerve root, but also the vertebral artery. These were successfully decompressed by this technique. Small fragments of bone securely adhering to the vetebral artery were not removed, provided the vertebral artery was decompressed by the osteophytectomy.

All 15 patients with *myeloradiculopathy* underwent an uncoforaminotomy at one disc level for decompression of the involved root, which was directly observed to be compressed by lateral or posterolateral bony spurs at the uncovertebral joint. Anterior decompression was performed at one disc level in 5 patients, at two sequent levels in 7, and at three in 3. Anterior decompression of 2 sequent disc levels was obtained by corporectomy in 2 patients. In the 3 patients in whom three sequent discs were involved, a corporectomy was used for two disc levels, and Smith-Robinson's (1958) procedure was performed for anterior decompression of the other level. The corporectomy was followed by an anterior bone graft.

No vascular problems occurred during surgery.

Temporary paresis of the deltoid muscle was observed in 2 of 35 patients and Horner's syndrome in 1; the patients recovered within a few weeks without treatment.

The median follow-up time for surgery was 6 (2–8) years.

Results

At follow-up the radiographs in all 35 patients showed solid interbody fusions with a firm-fitting graft, and that the posterior, lateral, and anterolateral spurs had been removed (Figure 2).

In the radiculopathy group, radiating pain disappeared immediately in all the patients, whereas muscle strength was gradually restored. At the follow-up, 19 of 20 patients had no neurologic symptoms. One patient had slight numbness in the thumb, which did not affect work or daily activities.

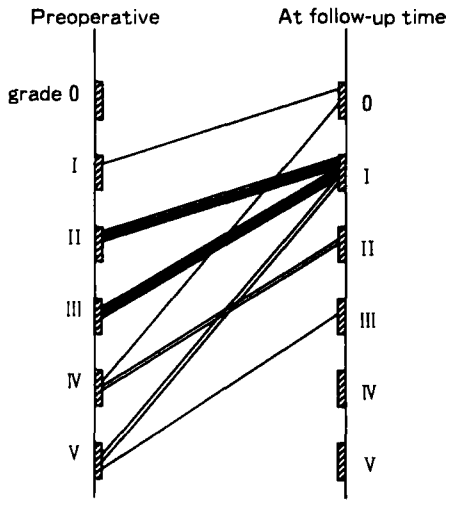
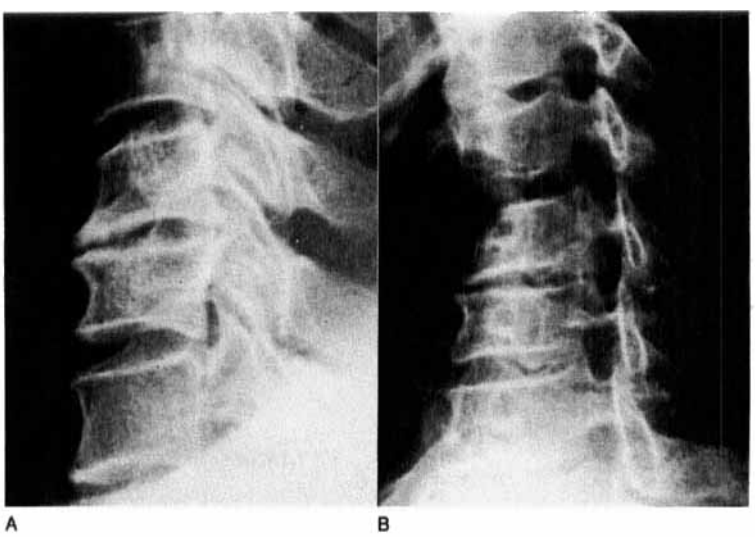


Figure 3. Disability associated with cervical spondylotic myelopathy graded according to a modified Nurick scale.



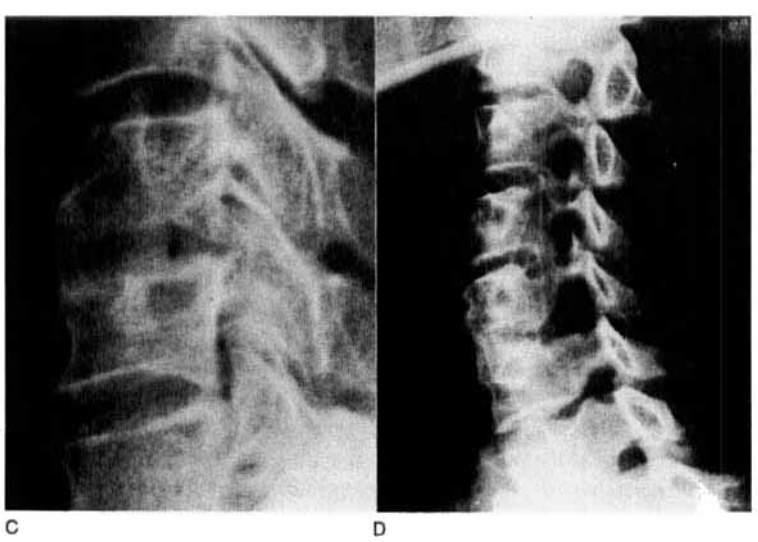


Figure 2. Case 26. A 52-year-old man had a 9-month history of slight difficulty in walking and muscle weakness in an arm with radiating pain. He had cervical *spondylotic myelopathy* of Grade II with radiculopathy signs of the C6 nerve root. Three years after surgery (C, D), he had no difficulty in activities of daily living in spite of slight spasticity, and he had no radiculopathy.

A. Narrowed disc with posterior spur at C5/6 is demonstrated in the lateral view.
B. Narrowing of the intervertebral foramen by *spondylotic spur* at the same level in oblique view.
C. Lateral view showing anterior decompression with rigid fusion.
D. Oblique view showing the enlarged intervertebral foramen.

In the myeloradiculopathy group the radicular pain disappeared immediately after surgery, the spasticity of the lower limbs and the muscle weakness of the upper limbs improved gradually, then the sensory disturbances improved, and lastly the pyramidal pathologic signs disappeared. At follow-up, nerve root signs were observed in 3 patients in whom slight sensory disturbances persisted in the hand. All 15 patients recovered substantially (Figure 3), and 14 were able to continue their work. The preoperative ataxia, cervical angina, and sphincter involvement in 8 patients had disappeared.

Discussion

About 20 years after the first report by Elkin and Harris (1946), who exposed a vertebral artery by the lateral approach, Hardin (1965), Gortvai (1964), Jung and Vierling (1965), and Jung et al. (1974) showed that the vertebral artery could be decompressed by exploration in its canal and removal of spondylotic spurs. This approach was introduced by Jung and Vierling (1965) for the removal of osteophytes compressing cervical nerve roots. The technique was extended by Verbiest (1972 a, b) for the treatment of lateral disc protrusion, cervical spondylosis, spinal tumor, and traumatic lesions of the brachial plexus. Kehr et al. (1981) reported that the displaced or narrowed vertebral artery and compressed or irritated cervical nerve roots should be treated by uncosectomy and uncoforaminotomy.

Spondylotic spurs in the cervical spine may cause both neural and vascular compression: a posterior spur may compress the cervical cord, a posterolateral spur may cause compression of a nerve root, and a lateral spur may compress a vertebral artery. A posterior and posterolateral spur may thus compress both the cord and a nerve root, resulting in myeloradiculopathy. In these spondylotic conditions, posterolateral or lateral spurs can be excised by anterolateral uncoforaminotomy, safely obtaining decompression of nervous or vascular tissue.

In all the cases of radiculopathy in our series, brachialgia and weakness of associated muscles disappeared after surgery. In 18 of the 20 patients with radiculopathy, lateral and posterolateral spurs existed continuous with posterior spurs, so that not only nerve roots, but also the cervical cord was decompressed by the removal of the chain of spurs with the technique used. In Williams' (1983) operative series, a thorough foraminal decompression seemed effective for spondylotic radiculopathy because radicular pain was largely the result of nerve root irritation as it passed through the cervical foramen. We found the target cord-root complex to be compressed backwards by the bony spur; this corresponds with the postmortem report of Holt and Yates (1966).

A corporectomy was used in 5 myeloradiculopathy patients to decompress the cord at two sequent disc levels. Of these, a nerve root was relieved by anterolateral uncoforaminotomy at one level. This combined corporectomy further ensured anterior decompression of the cord compared with transdiscal intervention at two adjacent levels, and an anterior bone graft secured union in double-level fusions. We reported (Manabe and Tateishi 1986) that corporectomy has several advantages, the most important of which is that the addition of lateral decompression is easily possible at two adjacent disc levels that may be associated with radicular symptoms.

As a neurologic complication of this technique, 2 patients in our series developed transient weakness of the deltoid muscle. Kehr et al. (1981) pointed out that this paresis might result from a technical error in which the brachial plexus was compressed at surgery. The other complication was Horner's symptom caused by surgical trauma affecting the cervical sympathetic truncus.

Good results from posterior surgery for spondylotic myeloradiculopathy and radiculopathy have been reported (Henderson and Hennessy 1983, Fager 1978, Epstein et al. 1969). However, if cervical canal stenosis is not present, the most rational route to a bony spur continuous from the uncovertebral joint to the posterior ridge of vertebral bodies is a combined anterior and lateral approach. Furthermore, whereas posterior wide laminectomy combined with posterior facetectomy to decompress a nerve root may occasionally produce a deformity or instability of the cervical spine, anterolateral uncoforaminotomy usually provides complete decompression for the nerve system and good stability for the cervical spine is secured by anterior interbody fusion.

When the preoperative examination has identified the compromised cord-root complex, notably by CT-myelography, decompression ought to be achieved by the combined operation. Intraforaminal or lateral spurs are also removed safely with the protection of the vertebral artery by transversectomy. The other indication is for the removal of disc fragments migrating to a nerve root because uncoforaminotomy exposes both anterior and posterior aspects of the root. Prior to surgery a vertebral angiography is necessary to determine the position of a bony spur in relation to the vertebral artery and to identify arterial compression.

Our analyses indicate that anterolateral uncoforaminotomy is the procedure of choice for patients who need decompression of the cord-root complex for spondylotic radiculopathy alone or combined with myelopathy.

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