Spondylolysis after posterior decompression of the lumbar spine

35 patients followed for 3–9 years

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Radiographs were examined in 35 patients who had had posterior decompression without fusion of the lumbar spine. Spondylolysis was found in 10 patients. Segmental range of motion, degree of vertebral slippage and width of decompression were analyzed by radiography. There was greater vertebral slippage after surgery in patients with postoperative spondylolysis than in those without spondylolysis. We conclude that excessive bony decompression may cause postoperative spondylolysis.

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Acquired spondylolysis after spinal fusion has often been reported as a postoperative complication (Anderson 1956, Shaw and Taylor 1956, Depalma and Marone 1959, Calabrese and Freiberger 1963, Harris and Wiley 1963, Rombold 1965, Frymoyer et al. 1978, 1979, Brunet and Wiley 1984, Blasier and Monson 1987). Altered biomechanics of the spine, abnormal stress concentration, and operative damage to the posterior elements have been suggested as causative factors (Depalma and Marone 1959, Calabrese et al. 1963, Brunet and Wiley 1984). To our knowledge, no report has described spondylolysis after posterior decompression without spinal fusion. We detected spondylolysis in the segment operated on.

We report the incidence of spondylolysis after posterior decompression without fusion with a comparison analysis of patients with and without spondylolysis.

Patients and methods

51 patients underwent posterior decompression without spinal fusion and/or facetectomy at our hospital from 1982 to 1988. Thirty-five of these patients, 12 women and 23 men, were able to return to our department for evaluation. Before surgery, they showed no spondylolysis in the segments operated on. The mean age at the time of operation was 60 (30–84) years. The mean follow-up period was 5 (3–10) years. The diagnoses were lumbar spinal canal stenosis (22), lumbar degenerative spondylolisthesis (13), neurinoma of the cauda equina (1), and intradural arachnoidal cyst (1). Conventional laminectomy was performed in 26 patients and suspension laminotomy (Ohmori et al. 1987) in 9 patients. The mean number of laminae operated on was 2.7 (1–5); T12 in one patient, L1 in 2, L2 in 6, L3 in 21, L4 in 34, and L5 in 30 patients. The total number of examined pars interarticularis corresponding to laminae operated on was 188.

At review, plain radiographs of the lumbar spine were obtained (anteroposterior, lateral, functional and 45 degrees oblique projection) in all patients and bilateral oblique tomographies in 16 patients. The functional views were taken in the standing position with full flexion or extension of the lumbar spine. The oblique tomograms were taken with the spiral system to determine indefinite spondylolysis.

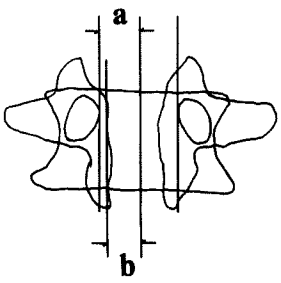
The width of decompression was measured and expressed as percentage of the midline–pedicle distance (Figure 1). The segmental range of motion (ROM) of each intervertebral space subjacent to the operated segment was measured on the lateral radiographs in full flexion and extension before and after surgery. The degree of vertebral slippage of each vertebra corresponding to the lamina operated on was also measured before and after surgery.

Patients with and without spondylolysis were compared using the Chi-square test, Mann-Whitney or Wilcoxon nonparametric tests with a significance level of 5 percent.

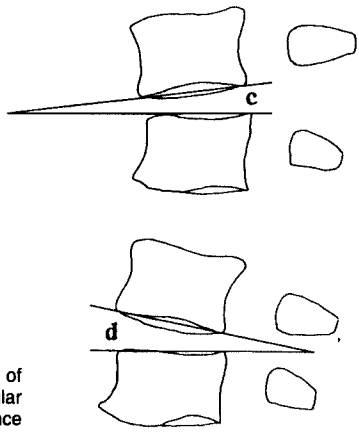
Results

Spondylolysis was found in 10 of the 35 patients after surgery. 4 patients had been treated with conventional laminectomy and 6 with suspension laminotomy. The

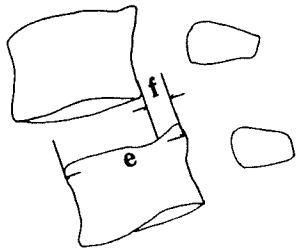
Figure 1. Radiographic measurements.



On the anteroposterior radiograph, the midline of each vertebra was determined as a perpendicular bisector of the interpedicular line. The distance from midline to medial margin of each pedicle was called (a). The width of decompression (b) was the distance from midline to margin of the laminectomy or laminotomy. The percentage of decompression was calculated as b/a x 100.



The segmental ROM is the angle (c) plus (d).



The percentage of vertebral slippage is calculated as f/e x 100.

number of spondylolyses was 19 of 188 pars interarticulares. The distribution of spondylolysis was 1 in L2, 9 in L3, 9 in L4, and no spondylolysis in L5.

The mean number of laminae operated on was 3.3 in patients with spondylolysis and 2.4 in patients without spondylolysis ($P < 0.005$). The percentage decompressed width in laminae was 85 with spondylolysis and 56 without spondylolysis ($P < 0.005$). The mean ROM of segments with spondylolysis was 5.7° before and 6.1° after surgery, and that of segments without spondylolysis 5.2° before surgery and 5.1° after. No differences were observed in these data, either before or after surgery, or with or without spondylolysis. The degree of slippage of vertebrae with underlying spondylolysis averaged 2.6 percent before surgery and 6.0 after ($P < 0.05$), while that of vertebrae without spondylolysis was 2.2 before surgery and 2.9 after. There were no differences between pre- and postoperative slippage in patients without spondylolysis, or between cases with and without spondylolysis (Table 1).

Acquired spondylolysis (Table 2) was found in 4 of 26 patients with conventional laminectomy (Figure 2) and in 6 of 9 with suspension laminotomy (Figure 3). The number of spondylolyses was 5 of 128 pars interarticulares in the former, and 14 of 60 in the latter ($P < 0.01$). The mean percentage of decompressed width of the segments operated on by conventional laminectomy was 53, and that by suspension laminotomy 71 ($P < 0.01$). In the segments with spondylolysis, the rate of decompressed width was greater ($P < 0.01$), 78 percent versus 88 percent. In the segments without spondylolysis, similar results were obtained ($P < 0.005$), 52 and 66 percent, respectively.

Table 1. Radiographic measurements in 35 patients after posterior lumbar decompression. Mean *SD*

	With spondylolysis n 10		Without spondylolysis n 25	
Percentage decompression width	85	*8.3*	56	*13.1*[a]
Number of laminae operated on	3.3	*0.8*	2.4	*0.7*[a]
Segmental ROM (degrees)				
before	5.7	*4.5*	5.2	*3.9*
after operation	6.2	*4.5*	5.1	*4.7*
Percentage vertebral slipping				
before	2.6	*7.9*	2.2	*5.8*
after operation	6.0	*14*[b]	2.9	*7.0*

[a] $P < 0.005$, with versus without spondylolysis.
[b] $P < 0.05$, before versus after operation.

Discussion

To our knowledge, lumbar spondylolysis after posterior decompression has not been previously reported. Usually, only anteroposterior and lateral radiographs are obtained after surgery. Therefore, spondylolysis is not easily detected in routine follow-up examinations, whereas it can be more reliably detected by oblique views.

We tried to clarify the causative factor of postoperative spondylolysis. The width of decompression was greater and the number of laminae operated on was higher in the segments with spondylolysis than in those without. These results suggested a causal

Table 2. Data on 10 patients with acquired spondylolysis after posterior decompression

Case	Age	Sex	Spondylolisthesis preop. (%)	Level of decompr.	Spondylolysis postop.[a]	Percentage decompression	Follow-up (mos)	Symptoms at latest follow-up	Spondylolisthesis at follow-up (%)
1	58	F	25	L3–5	L4 r	97	62	Low back pain	44
					L4 l	86			44
2[b]	34	M	0	T12–L3	L3 l	93	59	None	0
3	49	M	0	L3–5	L3 r	87	80	Low back pain	11
					L4 r	96			15
4	58	M	0	L4–5	L4 r	77	49	None	0
5	60	M	0	L2–5	L2 r	81	60	None	0
					L3 r	88			0
					L3 l	90			0
					L4 r	90			0
					L4 l	84			0
6	76	M	0	L3–5	L4 l	70	49	Low back pain	0
7	68	M	12	L3–5	L3 l	86	54	Low back pain	0
8	61	F	0	L3–5	L3 r	69	81	None	0
					L4 l	87			0
9	53	F	0	L3–5	L3 r	92	60	Low back pain	0
					L3 l	90			0
10	46	F	0	L1–5	L3 r	88	116	None	0
					L4 r	70			0

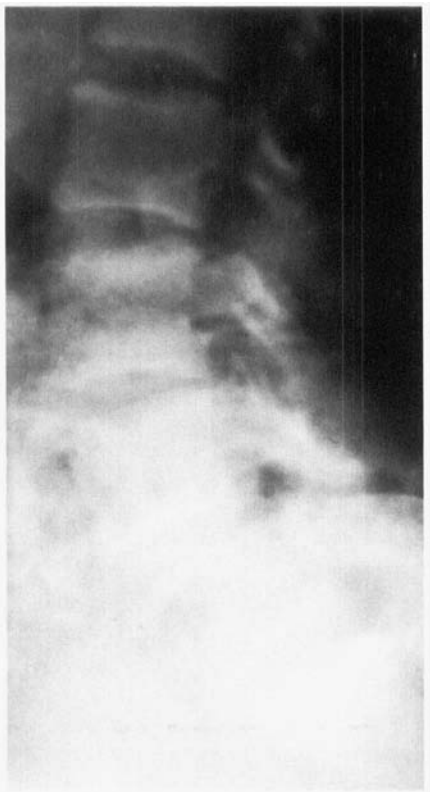
[a]r right side, and l left side.
[b]Intradural subarachnoidal cyst with paraparesis.

Figure 2. Case 4. A 58-year-old man with laminectomy of L4 and L5.

Left-to-right-oblique view before surgery. No spondylolysis was detected.

Left-to-right-oblique view after surgery, showing a spondylolysis in L4.

Figure 3. Case 1. A 58-year-old woman with suspension laminotomy for degenerative spondylolisthesis in L4.



Lateral view before surgery.

Lateral view after surgery, showing deterioration of the spondylolisthesis.

relationship between acquired spondylolysis and the extent of decompression. The reason might be that extensive decompression weakened the pars interarticularis. A decompressed segment above 75 percent in width over 3 laminae might mean a risk of spondylolysis.

The incidence of acquired spondylolysis was higher after suspension laminotomy than after conventional laminectomy. The width of decompression of the segments operated on by suspension laminotomy was greater than that of those operated on by conventional laminectomy. These facts indicate that the different incidences of spondylolysis resulting from these two surgical methods were caused by a difference in the width of decompression.

It has been reported that the interpedicular distance is greater at L5 than at other lumbar segments (Hinck et al. 1966). This may explain why the decompressed width was smaller at L5 than at the other lumbar segments and why no spondylolysis was found in L5.

Most patients with acquired spondylolysis after posterior decompression complained only of mild low back pain and they had no significant neurological deficit. However, the degree of vertebral slippage increased postoperatively in the segments with spondylolysis. The reason was probably that the spondylolysis after posterior decompression had caused instability in the segment involved. To prevent this instability, fusion should be considered, notably in cases of degenerative spondylolisthesis with marked instability before surgery. Also, as descriptions in previous reports have shown (Anderson 1956, Shaw and Taylor 1956, Depalma and Marone 1959, Calabrese and Freiberger 1963, Harris and Wiley 1963, Blasier and Monson 1987), attention should be paid to the possibility of spondylolysis in adjacent segments.

The results of this study indicate that extensive decompression may cause spondylolysis. Therefore, in posterior decompression of cauda equina, bony resection should be minimized. When extensive decompression is unavoidable, there is an increased risk of spondylolysis after surgery, and the patient should be followed up carefully with appropriate oblique and functional radiographs.

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