Surgical treatment of nerve root compression caused by scoliosis of the lumbar spine

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Effective relief of radicular pain and recovery of function is reported in four elderly patients with lumbar scoliosis following surgical decompression of the lateral recesses of the spinal canal. The operation includes laminectomy or hemilaminectomy with unroofing of the lateral recesses and foramina by medial facetectomy or facetectomy. The patients tolerated surgery without morbidity, were walking within 2 or 3 days, and recovered without incident. The pathological anatomy and operative criteria are discussed.

KEY WORDS - lumbar scoliosis - elderly patients - spondyloarthrosis - nerve root compression - decompressive laminectomy - facetectomy

For the purposes of this discussion the term "scoliosis" includes congenital or acquired curvatures of the thoracolumbar or lumbar vertebrae, including those with rotary curves developing later in life. While scoliosis alone does not cause statistically significant incidence of low-back pain in patients under 60, signs of neural compression may appear with further aging. This is the result of progressive stenosis of the foramina within the concavity of the scoliotic curve where narrowing is caused by a degenerative arthropathy manifested by hypertrophy of the posterior facets and the production of marginal vertebral osteophytes. Thickening of the lamina and ligamentum flavum with consequent shingling further reduces the available space in the spinal canal, particularly in its lateral recesses. This can result in compressive neuropathy characterized by radicular pain, weakness, atrophy, and severe incapacitation unresponsive to conservative care.

Lasting relief can be achieved by extensive dorsal decompression of the entire concavity of the lumbar spinal canal by means of hemilaminectomy or laminectomy over multiple segments. Liberal unroofing of the foramina must be accomplished, requiring medial facetectomy or the sacrifice of single or multiple facets. Because of associated spondyloarthrosis, advanced disc degenera-
tion, and spontaneous interbody fusion in this age group, the spinal column is stable and can tolerate facet removal.

The four patients we are reporting had severe scoliosis and associated neural compression syndromes, and all obtained lasting relief by means of decompressive procedures.

Case Report

Case 1

A 78-year-old woman had a 2-year history of severe low-back pain radiating deep into the left buttock, and down the posterior and lateral aspects of the left leg to the dorsum of the foot. The pain occurred spontaneously, increased in severity, and was aggravated by standing and walking. After walking one or two blocks, she had to sit or lie down for relief, following which she could again walk. There was no evidence of peripheral vascular disease. She had restricted straight-leg raising of moderate degree, with minimal weakness of the extensor hallucis longus on the left side and slight sensory changes along the inner aspect of the foot and leg. Roentgenograms disclosed severe lumbar scoliosis, convex to the left, with rotational deformities and a compensatory thoracic curve. Advanced spondyloarthrosis was present in the concavity of the lumbar curve. She did not improve with conservative treatment, but initially surgery was deferred because of her age.

Seven months later, the pain had become demoralizing. Interlaminar exploration was done elsewhere at both the L3-4 and L4-5 interspaces with excision of marginal osteophytes and of a degenerated disc at the L4-5 interspace on the left side. Only small foraminotomies were performed. The intervertebral disc at L3-4 had collapsed and spontaneous interbody fusion had occurred. Postoperatively, she improved rapidly, and was essentially pain-free for 2 months when the symptoms returned with unrelenting intensity.

She was admitted 18 months after the first operation with pain radiating down the left leg. Advanced atrophy and weakness were present in the left anterior tibial and hamstring muscle groups. There were sensory changes over the lower lumbar and first sacral dermatomes. The ankle reflexes were absent bilaterally. Straight-leg raising was not restricted. X-ray examination was unchanged and still showed advanced spondyloarthrosis in the hollow of the lumbar curve on the left side. Arthrotic changes in the vertebral bodies and in the posterior facets at L3-4, L4-5, were regarded as contributing to severe foraminal stenosis (Fig. 1 left). Myelography again revealed foraminal defects at L3-4 and L4-5 in the hollow of the scoliotic curve with ventral intrusion of spurs into the canal at each level and a dorsal intrusion at L4-5 (Figs. 1 center and right). She was re-explored in June, 1972; hemilaminectomy with wide decompression of the lateral recesses and foramina over the entire course of the nerve roots at L3-4, L4-5, and L5-S1 was done. Medial facetectomy and sacrifice of the inferior articular facets at two levels was performed. Interbody fusion was present at both L3-4 and L4-5 interspaces. She tolerated the surgery without incident, walked on the third hospital day, and was discharged after 2 weeks free of radicular pain and with minimal back discomfort. Symptoms of claudication did not recur. Motor power improved, but minimal atrophy remained. Reflexes did not return, but sensory changes resolved.

Case 2

For 3 months this 74-year-old diabetic woman had experienced pain radiating into the left hip and left leg. Sitting or lying in bed aggravated symptoms. After walking two to three blocks, pain increased and her leg buckled. Reflexes were absent bilaterally, and there was severe weakness and atrophy of the left quadriceps and the anterior tibial muscle group. Perception of vibratory sensation was decreased in both feet. Pinprick was slightly diminished along the inner aspect of the leg and foot. The Lasègue sign was markedly positive. Spine films disclosed a prominent scoliosis involving the thoracic and lumbar spine with the apex of the curve at the L2-3 level and marked arthrosis confined to the hollow of the lumbar curve on the left. Myelography showed a sharp defect at L3-4 caused by osteophytosis of the vertebral margins and of the posterior facets. Lesser defects were seen at the lower two levels. Operation included left hemilaminectomy of L2, -3, -4, -5, with unroofing of the stenotic lateral recesses and medial facetectomy at these levels. The patient made a remarkable recovery. The radicular pain resolved completely after 2 weeks. Symptoms of claudica-

J. A. Epstein, B. S. Epstein and L. S. Lavine
Root compression by lumbar scoliosis

FIG. 1. Case 1. Left: Plain films reveal a double curve in the lumbar region, the symptomatic area being in the concavity at L3-4, L4-5 (arrows). The degenerative arthrosis is conspicuous at L4-5 with lesser alterations at the adjoining levels. The normal markings of the apophyseal joints are obliterated. Center: Myelogram anteroposterior view, showing defects in the lateral recesses and foraminal zones at all three levels in the hollow of the curve (arrows). The defect caused at L4-5 is the result of dorsal intrusion of the hypertrophied joints into the canal and foramen and is evident immediately above the collapsed interspace. Right: Lateral view also showing intrusion above collapsed interspace (arrow, right). The spurs in the floor of the canal were small and of little clinical significance (arrows, left).

tion disappeared, and she was asymptomatic 9 months later.

Case 3

For 9 months following a fall this 66-year-old man experienced pain spreading from the buttock down the posterolateral aspect of the left leg. Symptoms were aggravated by standing, walking, and sitting. There was weakness and atrophy of the left quadriceps and anterior tibial muscle groups. The left patellar reflex was absent, and the ankle reflex was sluggish. There were no sensory changes. Straight-leg raising was unrestricted.

X-ray examination of the lumbar spine showed severe scoliosis convex to the right, marked by advanced disc degeneration and arthrosis of the posterior facets and the vertebral margins at multiple levels in the hollow of the curve. Myelography revealed a partial block at the L3-4 level with foraminal defects at L2-3, L3-4, and L4-5.

The operation consisted of left hemilaminectomy at L-2, L-3, and L-4 with extensive medial facetectomy and unroofing of the lateral recesses. Nerve roots were uncovered along their entire course. Excision of considerable portions of overgrowth of the posterior facets was necessary before root decompression was achieved. Small vertebral osteophytes were not disturbed. The vertebral spurs had united fusing the spine. The patient was ambulatory 2 days after operation, with relief of radicular pain. He was discharged 10 days later. Improvement has been sustained for the past 6 months.

Case 4

A 58-year-old woman had a 2-month history of low-back pain spreading deep into the buttock, groin, and down the posterior aspect of the left leg. When hospitalized in 1961 and again in 1962, multiple bone lesions having a foam-like pattern were discovered in the ribs, sacrum, and coccyx. Biopsy identified these as neurofibromata. She had had thoracolumbar scoliosis since childhood, and had worn a cast and a brace. X-ray examination of the lumbar spine revealed spondylotic overgrowth in the hollow of the lumbar lordotic curve. The osteoblastic sacral lesion had
not changed. The patient walked with a hesitant gait and had a marked right thoracic and left lumbar scoliosis associated with a sharp pelvic tilt. All back movements were restricted. A markedly positive left Lasègue sign was present. Neither bed rest nor traction provided relief.

Neurological examination revealed no weakness but there was hypesthesia over the L-5 and S-1 areas of the left leg. Reflexes were normal. Roentgenograms of the spine showed a rotational deformity and severe degenerative arthropathy in the lumbar region covering the three lowest levels of the spinal column within the hollow of the scoliosis (Fig. 2 left). On myelography, multiple defects were demonstrated in the lumbar canal with a partial block at the L3-4 level (Fig. 2 center). Operation consisted of laminectomy of L-3, L-4, and L-5 with removal of the upper half of S-1, and wide foraminal unroofing of L3-4, L4-5, and L5-S1 on the left. The inferior articular facet at the L-4 level was excised, and the osteophytes removed. Lesser foraminal decompression was performed on the right side. Nerve roots on the right did not appear remarkable, but those on the left were red and tied down in scar tissue. A soft disc at L4-5 was removed (Fig. 2 right). Postoperatively, there was early improvement in radicular pain, and groin pain did not recur. She walked without support when discharged from the hospital 2½ weeks later. She wore a brace for 3 months. Improvement has been sustained for the past 6 months.

Discussion

This small group includes three women, 58, 74, and 80 years of age, and one man of 66. Symptoms appeared spontaneously in three, were present for 2 to 9 months in three, and for 2 years in another. Pain was unilateral and without remission. Two patients had signs of claudication, primarily pain and weakness that increased on standing and walking, and was relieved by sitting or lying down. None had peripheral vascular disease. Sphincter function was intact. Weakness in three patients involved the quadriceps, and the anterior tibial muscle groups. Sensory changes were present in two, and covered multiple dermatomes from L-4 through S-1. Muscle atrophy was present in three of the

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**Fig. 2. Case 4.** Left: Marked lower lumbar scoliosis with "honeycomb" appearance of the sacrum attributed to "neurofibroma" diagnosed in 1961. The outline of the posterior articulations is obscured by advanced arthropathy. A block to the flow of Pantopaque is seen at L-3. There is a near complete block on the lateral myelogram at the apex of the curve at L3-4, droplets pass by and accumulate in the terminal end of the dural sac. Center: The major block occurs at L3-4 where the lateral tapering of the terminal column of oil immediately above the interspace indicates facet intrusion dorsally. Right: Drawing of operative decompression by laminectomy and foramintomy with medial facetectomy at L3-5 on the left.
patients, primarily of the pre-tibial group. Only one patient had normal reflexes. The others had absent or barely perceptible responses on the involved side. Two patients showed positive Lasègue signs.

Plain films of the spine showed thoracolumbar scoliosis with severe arthrosis in the hollow of the lumbar curve involving multiple levels from L2-3 through L5-S1. The most prominent changes were found at the L3-4 and at L4-5 interspaces. The clinical findings suggested neural entrapment with primary motor abnormalities.

Despite their age, each obtained surgical relief of pain without complication. All were ambulatory within 2 to 3 days. They were discharged after 10 to 18 days, maintaining their improvement at a self-sustaining level. While the reflex status did not change, motor power recovered and atrophy slowly resolved. Straight-leg raising became unrestricted. Claudication did not recur. Back supports were used for only brief intervals of 1 to 3 months in three patients. Recovery has been sustained for 6 to 18 months postoperatively. In three, surgery was initially considered to be too hazardous because of the patient's age and advanced degenerative arthrosis.

The symptoms of neurogenic claudication caused by stenosis in the lateral recesses and the foramina were similar to those encountered in congenital narrowing of the spinal canal and apophyseal arthrosis. The effects of disc intrusion and vertebral osteophytes were minimal compared to the compressive changes caused by the arthrotic overgrowth of the lamina and posterior facets. Relief was achieved by dorsal decompression of the lateral recesses and foramina confined to the hollow of the scoliotic curve where maximum compression of the L-4 and L-5 nerve roots occurred.

A review of the literature on idiopathic scoliosis discloses little reference to pain and neurological changes caused by lumbar nerve root compression especially in elderly patients. In a group of 195 patients from 32 to 64 years of age with idiopathic scoliosis, followed by Collis and Ponsetti for periods of 20 to 36 years, no statistical correlation could be established between the severity of back symptoms and the type and gravity of the spinal curvature. Dull back pain was the most common complaint, and only one patient complained of sciatica. Degenerative arthritic changes were noted in only 4%, the severity of the osteoarthritic change being unrelated to the degree and type of spinal curvature.

In patients with infantile and acquired scoliosis, whose curves continue to increase after maturation, degeneration is most pronounced at the apex of the normal curvature where stress is greatest. A definite correlation exists between the maximal mechanical stress in this region and the lateral shift of the vertebra. Risser and Wiltse suggested that degeneration and thinning of the intervertebral discs at the points of greatest stress was a common cause of increasing scoliotic deformity when vertebral growth had ended.

We have observed that when nerve root compression does occur, it is confined to the foramina within the concave portions of the spinal curvature, no matter what the cause. These openings are narrowed by the shortening of the distance between the pedicles and by productive, arthrotic changes involving the posterior facets and the articular margins of the vertebral bodies. Shingling, thickening of the lamina, and hypertrophy of the yellow ligaments are additional contributory factors.

Collins indicated that in functional or postural scoliosis, the side-to-side spinal curve is gradual without limiting physiological mobility and posture. No permanent changes in the shape of the vertebra or of the disc are present. In structural or true scoliosis, a permanent distortion of the spine occurs accompanied by adaptative changes in the form and shape of the vertebra and of the intervertebral disc. The lateral curve is asymmetrical, and rotation of the vertebral bodies results in a wedge-shaped deformity of the vertebra and the discs at the level of the greatest curve.

In patients with acquired scoliosis, the nucleus pulposus shifts to the wider side of the intervertebral space where sclerosis of the annular fibers makes the distortion permanent. Sideward tilting of the vertebra encourages the extrusion of the disc substance into the concavity of the spinal curve. Herniations of the degenerating annular fibers lateral to the anterior spinal ligament contribute to the formation of marginal osteophytes and ultimately fusion. The incidence of pain is not increased except in patients beyond 65 years of age.

Spinal curvatures incident to congenital
malformations, poliomyelitis, syringomyelia, neurofibromatosis, and neoplasms rarely appear so late in life and, as a rule, have no gross intraluminal or foraminal effect.

Idiopathic lumbar scoliosis rarely causes disability except for changes in appearance and curvature. In later life, when the spinal curvature is influenced by postmenopausal and senile osteoporosis, backache and stiffness occur with referred pain spreading down the back of the thighs to the knees. The pain is not radicular and is not associated with the crippling neurological deficit encountered in the patients we have described. Straight-leg raising is not restricted.

Patients with unilateral sacralization may develop severe arthrosis on the side opposite the union between the costotransverse process and the sacrum. Scoliosis occurs on the side of the apophyseal arthrosis with foraminal nerve root compression.

Pedicular kinking may be an additional cause of nerve root compression in the sciotic spine. As unilateral narrowing of the disc occurs, the pedicle descends and impinges on the relatively fixed nerve root.

References
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