Intact arch spondylolisthesis

A review of 50 cases and description of surgical treatment

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Over the past 11 years, the authors have treated 50 cases of intact arch spondylolisthesis. There were 38 female and 12 male patients, and all but 11 were older than 60 years of age. Almost all had severe low-back pain made worse by standing or walking. Other common manifestations were unilateral leg pain, numbness or weakness of the leg, and evidence of mild cauda equina compression. Severe cauda equina compression was rare. Myelography invariably showed an extradural dorsal compression. A waist deformity was characteristic in many patients, but 12 had a complete block. In 15 patients (30%) the myelographic impression was that of a herniated intervertebral disc. Most subluxations were of L-4 on L-5. At operation, the facets were found to be thickened, distorted, and irregular. All patients were treated with a wide decompression and laminectomy, which included a medial facetectomy of the inferior and superior facets. An intervertebral disc was removed in 10 patients. Follow-up monitoring of 41 patients (for an average period of 36 months) showed that 26 (63%) were pain-free, 11 had less pain, and four were unimproved. Five other patients with short follow-up periods (average 5 months) were all improved.

Key Words: intact arch spondylolisthesis - lumbar spine - biomechanics - spinal cord decompression - subluxation

The history of the recognition and naming of spondylolisthesis has been reviewed by Newman and Stone, Wilte and Hutchinson, and others. It is summarized briefly here. In 1782, Herbiniaux, an obstetrician, was possibly the first to draw attention to the lesion. During the early part of the 19th century this disorder came to be called "luxation of the lumbosacral joint." In 1854, Kilian introduced the term "spondylolisthesis" to specify that the event was a forward movement of the last lumbar vertebra, not a backward movement of the sacrum. Later, anatomic dissections disclosed that this slippage was associated with a defect in the neural arch: the pars interarticularis. In 1930, Junghanns described a case of spondylolisthesis with an intact neural arch, which he termed "pseudospondylolisthesis." Several years later, however, Macnab pointed out that pseudospondylolisthesis is a misleading term, because there is a true slippage, whether or not the neural arch is intact. For cases where the arch is intact, he suggested the term "intact arch spondylolisthesis," the designation most commonly used today.

In 1963, Newman and Stone investigated the cause of spondylolisthesis associated with an intact arch, and, because they believed that osteoarthritis played a key role, they suggested that the condition be called "degenerative spondylolisthesis." However, since intact arch spondylolisthesis may also occur without degenerative disease (as in agenesis of the facets), Epstein, et al., proposed an all-inclusive term, "degenerative spondylolisthesis with an intact neural arch." Although its names are many, the condition itself is easily identifiable by its characteristic clinical symptoms and radiographic appearance.

We summarize the 50 cases of spondylolisthesis with an intact neural arch that have been treated surgically at the North Carolina Baptist Hospital, and discuss the pathophysiology of the disorder.

Summary of Cases

From 1972 through July, 1983, we operated on 38 female and 12 male patients with intact arch spondylolisthesis. The ages of these 50 patients ranged from 47 to 87 years (average age 66 years); only 11 of the
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patients were younger than 60 years. Forty patients were Caucasian, nine were black, and one was Hispanic.

Severe low-back pain was present in almost all patients and was made worse by standing or walking. The upright position was often so painful that the patients had to remain in bed. Leg pain (usually unilateral, but bilateral in 15 patients) was present in all but seven patients. It was often accompanied by numbness or weakness. Mild cauda equina compression was evident in some, manifested by neurogenic claudication, and signs of compression or a lesion distal to the level of spondylolisthesis or subluxation were present in over half of the patients. However, severe cauda equina compression with paraparesis and incontinence was rare, and the level was difficult to predict clinically.

Myelography almost invariably showed significant extradural compression, constriction of the dural sac, dorsal compression, and a characteristic waist deformity (Fig. 1 left). There was complete block in 12 patients. Compression of the nerve root by the irregular, overgrown facets was not easily or consistently demonstrated myelographically. In 15 patients, the preoperative myelograms gave the impression of a herniated disc (Fig. 1 right), a finding that was confirmed at operation in only seven patients.

The extent of subluxation varied from 6 to 10 mm. The sites of subluxation are given in Table 1. One of the cases of retrolisthesis may have been caused by trauma.

All patients were treated with wide decompression and laminectomy, which included a medial facetectomy of the inferior and superior facets. In many, the facets were thickened and distorted, and the bone was removed with difficulty. Spinal fusion was performed in four patients; they had all been referred to us by orthopedic surgeons and a combined procedure was carried out. One of the patients had undergone two prior operations on her spine; two suffered spinal "instability" sufficient to lead the orthopedist to believe that fusion would be beneficial; and one had a reoperation with wide decompression.

A protruded or bulging intervertebral disc was found in 11 patients; most commonly one level higher than the spondylolisthesis. An extruded disc was found in seven patients, two of whom had spondylolisthesis at L4–5 and disc extrusion at L5–S1. In all, 10 discs were partially or totally removed. Six patients had undergone a prior laminectomy at the site later operated on for spondylolisthesis, and removal of scar tissue was often a problem. In the remaining patients, the transverse ridges created by bulging discs were not a factor in compression after the laminae and medial facets had been removed, and usually the anulus fibrosus was not opened nor was the disc material removed.

A follow-up period of 6 to 131 months (average 36 months) in 41 patients indicated that 26 were essentially pain-free; 11 had much less pain, some of whom still had back pain but no leg pain. Four patients did not show improvement; one of these required an additional operation for pseudospondylolisthesis one level above her previous operation, and one has experienced slight additional slippage of the spinal deformity. Of the remaining nine patients, one has died, three are lost to follow-up evaluation, and five were operated on within 4 months of the date of this report. All of the last five had a good report when most recently seen.

Representative Case Reports

Case 1

This 63-year-old woman had a 10-year history of pain in her lower back and right leg. A myelogram obtained at another hospital was interpreted as showing a herniated disc, and she underwent interlaminar discectomy. Postoperatively, her pain did not resolve and she developed fecal and urinary incontinence, as well as weakness of the dorsal and plantar flexor muscles. She was referred to the North Carolina Baptist Hospital.
Plain roentgenograms of the lumbar spine showed anterior subluxation of 9 mm at the L4-5 level, with arthrosis of the facets at that level. A lumbar myelogram showed a complete block at the L4–5 level. The patient underwent a wide laminectomy of L-4 and L-5 with medial facetectomy and removal of fibrocartilage extruding through an opening in the anulus fibrosus. Postoperatively, she regained bladder and bowel continence; her leg pain and weakness resolved; and her back pain, although still present, was well tolerated.

Case 2

This 59-year-old woman had had back pain for many years. Three months before her present hospital admission, the pain in her back spread to her buttocks and was so severe that she could hardly walk. She had no pain in her legs, no straight-leg raising limitations, and no bladder or bowel incontinence. Roentgenograms of her back showed an intact arch spondylolisthesis at L-4, and myelography showed an almost complete block at that level. She underwent a complete laminectomy extending from part of L-3 through L-5. The bone was extremely hard. Where a marked constriction had been seen myelographically, we found heavy overgrowth of the laminae and inferior facets of L-4, which had to be removed before we could visualize the superior facets of L-5. The superior facets of L-5 had numerous excrescences of bone and attached ligamentum flavum; the overgrowth was such that the facets nearly met in the midline. Decompression of the L-5 roots was effected by removal of much of the medial side of the L-5 facets bilaterally. There was no disc protrusion. Postoperatively, the patient had normal range of motion and was free of pain.

Discussion

This series of 50 patients is small, representing 4.5 patients per year; however, 19 of the patients were seen and treated during the past 17 months. This increase in patients seen yearly may reflect better recognition of the disorder, or may reflect the fact that our general population is aging.

Spondylolisthesis with an intact arch and spondylolisthesis associated with a defective pars interarticularis have different profiles. Defective pars interarticularis spondylolisthesis is usually found at the L5–S1 spinal level and occurs most often in young people; it may show a much greater degree of subluxation than spondylolisthesis with an intact arch, which rarely has a subluxation greater than 1 cm. Intact arch spondylolisthesis occurs more commonly in the middle-aged to elderly woman and is usually encountered at the L4–5 level.

Intact arch spondylolisthesis can be explained by changes in the biomechanics of the lumbar spine that occur with age. As a person with a normal lumbar spine reaches physical maturity, there is a progressive degeneration of the discs, the supraspinous and intraspinous ligaments, and the cartilage of the facet joints. As the degenerative process continues, the axis of rotation of the lower lumbar spine moves from the region of the nucleus pulposus to the apophyseal joints. In addition, there is an increased range of anteroposterior intervertebral movement, which is accentuated by the forward shearing force on the lumbar spine caused by the erect posture. All of these undue movements and stresses cause deformity and degenerative changes in the joints. Of particular interest to this discussion is the striking deformity that occurs in both the inferior and superior facets, as well as the potential for forward slippage of the vertebras in the lower lumbar region.

The frequency of involvement of the L4–5 joint is explained by two anatomical characteristics of the lower vertebral spine: 1) the L4–5 and L5–S1 joints have the highest degree of mobility and hence the greatest stimulus for degeneration; 2) since the facet joints at the L4–5 level are aligned obliquely to the transverse plane, their degeneration creates a channel through which the inferior facets of L-4 can slide between the superior facets of L-5 (Fig. 2). The results of the slippage are compounded by the osteophytic spurs that develop over the years. These spurs project from both the margins of the vertebral bodies and the degenerating facets. As subluxation of the vertebral body occurs, the enlarged and deformed inferior and superior facets impinge upon the exiting nerve roots and produce the radicular symptoms. It can be appreciated how removing the arthritic facets decompresses the nerve root. The cauda equina compression results from the pincer action of the laminae as they slide anteriorly into the anterior osteophytes and disc that project from the margin of the vertebral body (Fig. 3). The subluxation rarely exceeds 1 cm (in this series it never exceeded 10 mm) because, as the inferior facets slip, they are stopped by the margin of the body of the next lower vertebra. This arrested subluxation protects the compromised canal from being obliterated, which explains the infrequency of a complete cauda equina syndrome.

There is considerable question about whether these defects should be fused or not. In this series we performed spinal fusion on only four cases, one in a patient who had had two previous operations on her lower back, and one in a patient with one previous operation; neither is considered to have a good result. Two fusions were carried out in patients with spinal instability, and both have done well. As with the patient with true spondylolisthesis, the osteoarthritic stability and decreased physical activity in the patient with intact arch spondylolisthesis increases as he or she ages, so the indication for fusion should diminish in patients over 50 years of age and should be rare after 60 years. We do not favor fusion unless instability can be demonstrated. Only one patient has shown increase in slippage at L-4 on L-5. She had removal of an extruded disc as well as decompression. She is doing well and the slippage is stable. She does not want further surgical care.

Many of these patients are sorely handicapped by
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FIG. 2. Drawing of a cross-section through the L-4 vertebra. Left: The normal relationship of the L-4 inferior facets and the L-5 superior facets. Right: Slippage of the L-4 inferior facets between the L-5 superior facets in a patient with intact arch spondylolisthesis.

FIG. 3. Upper: Reconstructed sagittal lateral computerized tomographic scans through the L4-5 joints showing normal joints (left) and intact arch spondylolisthesis (right). Lower: Corresponding line drawings showing the normal joints (left) and encroachment on the intervertebral foramen (right).

FIG. 4. Drawing showing the removal of a portion of the inferior facet in order to reach and remove the medial portion of the superior facet of L-5.

diseases other than their spinal deformity. Specifically, several have had myocardial infarctions, and some have had malignancies currently under control, chronic renal failure, diabetes, obesity, or parkinsonism. At least one of our patients had mild congestive heart failure when she entered the hospital for treatment of this disorder and of her back and leg pain. Almost all have osteoarthritis elsewhere, especially prevalent in the knees. However, if these particular problems can be brought under control and the operation performed safely, surgical treatment may be the most gratifying treatment for these patients.

Conservative measures (including exercise, rest, the application of braces, and the passage of time) were first tried in all of the patients operated on in this series. A few patients not reported in this series improved sufficiently with conservative therapy and were not operated on. Such conservative measures should always be tried first, and only if they fail is surgical treatment advised.

A more radical operation than we have performed has been advocated by Rosomoff for symptomatic intact arch spondylolisthesis. That procedure includes removing the pedicles of the vertebrae as well as the facets. Although the incidence of instability in patients so treated may not be great, we do not advocate the use of such an approach. It is essential during this operation to take off the medial portion of the superior facet of L-5 if the subluxation is at the L4-5 level, and to reach the superior facet of L-5 one has to take off part of the inferior facet of L-4. Figure 4 illustrates this approach. Whether the patient has a protruded disc is irrelevant.
since the roots must be decompressed. This is usually achieved by taking off the facets, and the disc problem is thus easy to approach and correct. Removal of a protruded disc is rarely indicated, since the compression is almost always from the overgrown facets dorsal to the roots rather than from the disc. Removal of a disc may contribute to instability.

In two cases of lumbar stenosis with severe symptoms and positive myelograms, only the facets encroaching on the roots were removed. Postoperative myelograms in both of these patients no longer showed the defects (Fig. 5), and even the anterior transverse disc protrusion in the lateral horizontal beam film was scarcely seen.

References


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